JPRS 77203

19 January 1981

Japan Report

No. 115

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50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. JPRS 77203	2.	3. Recipient's Accession No.

4. Title and Subtitle

JAPAN REPORT, No. 115

5. Report Date

19 January 1981

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

Joint Publications Research Service
1000 North Glebe Road
Arlington, Virginia 22201

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.

(C)

(G)

12. Sponsoring Organization Name and Address

As above

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

This serial report contains press and radio coverage on political, sociological, economic, military, and scientific and technological developments.

17. Document Analysis a. Descriptors

JAPAN
Political
Sociological
Military
Economic
Science and Technology

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group 5C, 5D, 5K, 15C, 16D, 18I, 19F, 22B

18. Availability Statement:

Unlimited Availability
Sold by NTIS
Springfield, Virginia 22161

19. Security Class (This Report) UNCLASSIFIED

20. Security Class (This Page) UNCLASSIFIED

21. No. of Pages 146

22. Price

See ANSI-Z39.18)

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

JPRS 77203

19 January 1981

JAPAN REPORT

No. 115

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POLITICAL AND SOCIOLOGICAL

JAPANESE CENSUS SHOWS SMALL GROWTH RATE

OW190211 Tokyo KYODO in English 0150 GMT 19 Dec 80

[Text] Tokyo Dec 19 KYODO--The total population of Japan as of October 1 stood at 117,057,485, an increase of only 4.6 percent (5,120,000) from five years ago.

This was reported to the regular cabinet meeting Friday by Director General Taro Nakayama of the prime minister's office on the basis of the national census taken in October.

He said the rate of increase of the nation's population when compared with 1975 when the previous census was taken was the lowest in postwar years.

The low increase rate was attributed to the continuing decline in the birth rate since 1973.

Of the population, males accounted for 57,593,074 and females, 59,464,411, indicating a ratio of 96.9 males per 100 females.

The number of households totaled 35,976,517, an increase of 6.6 percent from 1975.

The average number of household members stood at 3.25, virtually unchanged from the 3.32 in 1975.

By prefecture, the population in Tokyo declined 0.5 percent from five years ago for the first time after the war to total 11,615,069 but it still ranked top among the 47 prefectures.

It was followed by Osaka (8,470,000), Kanagawa (6,920,000), Aichi (6,220,000) and Hokkaido (5,580,000).

Tottori, facing the Sea of Japan in western Honshu, had the smallest population of 604,225. It was followed by Shimane (780,000), Fukui (790,000) and Yamanashi (800,000).

If a comparison is made with other countries, Japan dropped to seventh place from the sixth spot in respect to population after China, India, the Soviet Union, the U.S., Indonesia and Brazil.

The population density stood at 314 persons per square kilometer, ranking Japan fifth after Belgium, or unchanged from five years ago.

In the census taken in 1965, when movements of the population to major cities were conspicuous, most of the prefectures in the Tohoku, Hokuriku and Chugoku areas on Honshu Island and in Shikoku and Kyushu were hit by a drop in population.

The latest census showed, however, that the population increased in all of the prefectures, excluding Tokyo, with little gaps in the rate of increase.

But the rate of increase in prefectures located near big cities still was high.

It ranged between 8 and 14 percent in Chiba, Saitama, Ibaraki and Kanagawa prefectures, all located near Tokyo, and Nara and Shiga, located close to Osaka and Kyoto.

The census also showed that the sprawling phenomenon in areas surrounding Tokyo, Osaka and Nagoya has become further conspicuous.

Among the large cities, the population of Yokohama increased to 2,773,822, ranking it second next to the 8,350,000 of the 23 ward areas in Tokyo. It thus replaced Osaka (2,650,000) in the No. 2 spot.

The cities of Kumamoto and Kagoshima in Kyushu also saw their population increase to the 500,000 level.

Of the cities, towns and villages in the country, only 1,511, or less than half of the total, recorded a population drop.

This indicated the tendency seen in recent years of people moving to large cities returning to their native places.

CSO: 4120

BRIEFS

NTT POST--Tokyo Dec 19 KYODO--Nobuhiko Ushiba, former minister for External Economic Affairs, has turned down repeated requests that he take over the post of president of the Nippon Telegraph and Telephone Public Corporation (NTT), officials said Friday. They said Ushiba met with Chief Cabinet Secretary Kiichi Miyazawa Thursday night and informed him that he will not be able to accept the post. As a result, the meeting scheduled between Ushiba and Miyazawa Friday morning when the chief cabinet secretary was expected to formally ask Ushiba to become NTT president has been canceled. Posts and Telecommunications Minister Ichiro Yamanouchi met with Ushiba Thursday afternoon and asked Ushiba to assume the top post in the NTT. But Ushiba, who served in the past as vice foreign minister and ambassador to the U.S., told Yamanouchi that he would not accept the post due to health reasons and inexperience in management of public corporations. Prime Minister Zenko Suzuki, in a meeting with Yamanouchi Thursday morning, suggested that Ushiba was the most suitable person to succeed Tokuji Akikusa who has tendered his resignation to take responsibility for accounting irregularities involving the corporation. [Text] [OW190151 Tokyo KYODO in English 0212 GMT 19 Dec 80]

CSO: 4120

ASDF TO START F-4 ASIP IN FY 1981

Tokyo JPE AVIATION REPORT-WEEKLY in English 3 Dec 80 pp 5-6

[Text] The Air Self-Defense Force (ASDF) has proposed ¥769 million for an aircraft structural integration program (ASIP) to lengthen F-4EJs' life and ¥2,074 million for their modernization in a budgetary request for FY 1981.

Under the ASIP, flight recorders will be placed on all of F-4EJ fighters to collect airframe data, which will serve as the basis for maintenance and repair. This program is designed to lengthen the F-4EJ's life from the current 3,000 hours to 5,000 to 6,000 hours so that planned retirement of one F-4EJ squadron in FY 1987 could be extended. The ASDF is hopeful of lengthening the F-4EJ's life as the US Air Force has successfully extended the F-4's life to 5,200 hours.

The ASDF intends to procure computers and other equipment and establish a specific program in FY 1981, receive equipment in FY 1982 and collect data in FY 1983. Necessary maintenance and repair work is planned to start in FY 1985.

Under the modernization program, performance of F-4EJs will be improved so that they can serve as support aircraft for F-15J fighters. Fire control systems (FCS) will be replaced by advanced types used on the F-16 and F-18, while look-down functions will be reinforced. New AIM-7F Sparrow and AIM-9L Sidewinder missiles will be utilized. To improve electronics warfare capability, they will be quipped with modern ECM, ESM and IFF systems.

Furtheremore, combat flaps and leading edge slats will be mounted to upgrade their combat capability. Since the Israeli Air Force has successfully improved F-4s for air superiority missions, the ASDF expects that modernized F-4EJs will be able to counter Soviet fighters.

A master modernization schedule envisages designing of electronics equipment and airframe modification in FY 1981, receipt of equipment and modification components in FY 1982, testing and modifying airframes in FY 1983, and conducting practical tests for equipment in FY 1984. Full-scale modernization will start in FY 1987. But the ASDF has still to decide whether to modernize all of its F-4EJs.

Meanwhile, the modernization program does not include the accurate bombing black boxes of the 5010BH attitude control systems and refueling systems, which were removed from F-4EJs at the time of their procurement.

CSO: 4120

JDA TO ORDER FIVE XF-3 ENGINES FROM IHI IN MARCH

Tokyo JPE AVIATION REPORT-WEEKLY in English 17 Dec 80 p 2

[Text]

The JDA will place a ¥4,566 million order with Ishikawajima-Harima Heavy Industries Co. (IHI) for five prototype XF-3 small turbofan engines in March 1981 under the FY 1980 budget, following delivery of the XF-3-1 test engine in FY 1975 and the XF-3-20 in FY 1977. IHI has already submitted an estimate for fabrication of the five prototypes.

The XF-3 is a promising candidate to power the MT-X next-generation intermediate jet trainer, planned to be developed from FY 1981.

The Technical R&D Institute (TR&DI) of the JDA plans to procure five additional XF-3 prototypes in FY 1981. A total of ¥2,550 million for that purpose is incorporated into the JDA budget request.

The 10 prototypes will be used for preflight rating tests involving high-altitude performance, safety, reliability and durability from late FY 1981 to the middle of FY 1983. If fabrication and tests go well, the XF-3 engine research and fabrication program will finish at the end of the tests.

CSO: 4120

EXPERTS SUPPORT TO TAN-SAM INTRODUCTION

Tokyo JPE AVIATION REPORT-WEEKLY in English 17 Dec 80 pp 4-6

[Text] Civilian experts have drafted a report supporting selection of the Tan-SAM short-range surface-to-air missile and recommended the JDA introduce the domestically developed missile as early as possible.

They were asked to consider the Tan-SAM after Keigo Ouchi of the Democratic Socialist Party questioned the performance of the missile in the Diet in October.

Minister for Defense Joji Omura presented the report to the National Defense Council last week, asking for government approval of the Tan-SAM procurement program starting in FY 1981.

The JDA has requested about ¥25,800 million for FY 1981 to procure 10 Tan-SAMs for the GSDF and ASDF.

Encouraged by the report, it will seek funds at budget negotiations with the Ministry of Finance (MOF) until last December. However, the MOF, giving priority to financial reconstruction, is expected to reject all new defense procurement items, including the Tan-SAM. The MOF's budget draft is likely to omit funds for the Tan-SAM. But it is uncertain how the Tan-SAM funding problem will be settled eventually.

Details of the experts' report on the Tan-SAM follow:

1. Necessity of Short-Range SAMs

Short-range SAMs are an important part of Japan's comprehensive air defense system comprising various anti-aircraft weapons. In this context, Japan should procure short-range SAMs meeting its own mission requirements as early as possible.

2. Comparison of the Tan-SAM with Other Missiles

Foreign missiles, including the Roland and Rapier, have unique characteristics meeting requirements of the users. Although they have some improved capabilities over the Tan-SAM, it best meets Japan's requirements. Specifically, the Tan-SAM is more inferior in bad weather. But most other capabilities of the Tan-SAM are superior. The Tan-SAM also has sufficient technical growth potential, allowing for successive improvement to meet changes as they occur.

3. Capabilities

The Tan-SAM's inferiority in bad weather is not a problem during actual missions. Although the Tan-SAM leaves smoke trails that can be detected by intruding aircraft, the enemy aircraft cannot avoid the missile because of its limited turning ability during a short-range flight as well as the missile's excellent homing performance. There is little possibility of a Tan-SAM hitting friendly aircraft by mistake because its identification capability is superior to other missiles due to a detection range two times as great.

Although the Tan-SAM's higher price tag than the Roland has been pointed out, the gap between their lowest prices is not significant. If life cycle cost is considered, the Tan-SAM is less than the Roland.

The Tan-SAM is less vulnerable than foreign missiles to radio jamming. Furthermore, infrared ray countermeasures will be difficult to take against the Tan-SAM.

The Roland is more mobile than the Tan-SAM. But this is not a problem with requirements in Japan. The Tan-SAM has better all-direction performance than other missiles.

The Tan-SAM will contribute more than imported missiles to Japan's military technical development. It also has a higher growth potential since improvement of foreign missiles usually involves difficulties.

4. Recommendations on procurement

In order to acquire military equipment meeting Japan's defense requirements, we should study, develop and produce weapons on our own. Self-developed weapons can be improved to cope with changes in threats and technical upgrading. This will also lead to development of Japan's defense production setup and technology, and encourage engineers. Development and production of the Tan-SAM using Japan's electronics technology will pave the way for further technical advancement as well as development of other new missiles.

Advanced military technology could become a bargaining power in Japan's negotiations with foreign countries for introduction of foreign technology.

As recent rapid development in science and technology affects military technology, the "make and improve" principle should be adopted for weapons systems. In this respect, an active radar homing system and other new systems will have to be developed for the Tan-SAM to improve its all-weather capability and other performance aspects.

CSO: 4120

ALL-MODULE MAINTENANCE OF ADOUR TO START IN FY '81

Tokyo JPE AVIATION REPORT-WEEKLY in English 17 Dec 80 p 6

[Text] The ASDF is expected to introduce an all-module maintenance method for TF-40 Adour engines for T-2 supersonic trainers and F-1 support fighters.

So far, the ASDF has shipped engines to manufacturers' plants for overhaul. Under the new method, however, modulewise checks will be carried out so that some modules can be exchanged with new ones at airbases. New modules will be on hand at airbases and only modules requiring repair will be taken to outside plants.

The Adour engine will be divided into 13 modules, of which seven must be exchanged with new ones every 400 hours. Six other modules will be exchanged according to results of checks.

CSO: 4120

MILITARY

MSDF REQUESTS DRONE LAUNCHERS FOR UP-2J'S

Tokyo JPE AVIATION REPORT-WEEKLY in English 17 Dec 80 p 7

[Text] The MSDF has asked the JDA Central Procurement Office to procure BQM-34A high-speed target drone air launchers for the UP-2J firing training support aircraft as planned in the FY 1980 budget.

The UP-2J, a modified version of the P-2J antisubmarine patrol aircraft, will replace the S-2F-1U multipurpose aircraft as a firing training support aircraft. Two UP-2Js will become operational in FY 1983.

The UP-2J will be equipped with a missile detector simulator, a jamming system and a sleeve-type target drone tower as well as target launchers.

The first UP-2J was equipped with the missile detector simulator in FY 1979. The target tower of the S-2F-1U will be mounted from FY 1980 to 1981 and target launchers from FY 1981 to 1982.

In FY 1979, the second UP-2J was equipped with the target tower and the jamming system was procured for use from FY 1980 to 1981. The target launchers, to be procured in FY 1981, will be used from FY 1982 to 1983.

The MSDF also plans to modify two more P-2Js for obtaining electronic warfare data. The modified P-2J, named EP-2J, will carry the electronic warfare data collecting system. The system for the first EP-2J was procured in FY 1979 for use from FY 1980 to 1981. That for the second EP-2J is incorporated into the FY 1981 budget request with installation planned for FY 1982-83.

CSO: 4120

MSDF HOPES TO PROCURE FOUR DESTROYERS IN FY '81

Tokyo JPE AVIATION REPORT-WEEKLY in English 17 Dec 80 pp 7-8

[Text] The MSDF hopes to have its request for four destroyers for FY 1981 approved along with the FY 1981 fleet rehabilitation and modernization (FRAM) program involving two destroyers.

The four vessels costing about ¥164,500 million include a 4,500-ton DDG and three 2,900-ton DDs. The FRAM program is estimated at ¥19,300 million. These are part of the MSDF's FY 1981 shipbuilding plan totaling ¥264,400 million.

The FY 1980-84 Medium Term Defense Program (MTDP) envisages procurement of two DDG, 10 DD and four DE type destroyers--two DDs and one DE in FY 1980, the four in FY 1981, three DDs and one DE in FY 1982, one DDG and one DE in FY 1983, and two DDs and one DE in FY 1984. They are designed to replace 15 destroyers and 11 subchasers being decommissioned over the FY 1978-81 period. The four destroyers, if approved, will greatly contribute to maintenance of the current antisubmarine fleet strength.

The 4,500-ton DDG as a future mainstay of the escort fleet will perform better than a 3,900-ton DDG procured in FY 1978. A COGAG (combined gasturbine and gasturbine configuration) powerplant will be adopted instead of a steam turbine for the 3,900-ton DDG. It will be armed with Harpoon surface-to-surface missiles in canisters and the CIWS. A helicopter deck will also be mounted.

As for DDs, the MSDF started a program in FY 1977 for establishing a 20-ship fleet rapidly. Procurement of 20 DDs is expected to end by FY 1985.

CSO: 4120

MILITARY

BRIEFS

ASDF TO TEST T-1--The Air Self-Defense Force (ASDF) plans to conduct fatigue tests of the T-1 medium trainer in FY 1982 to discover how long its life can be extended prior to replacement by the MT-X next-generation medium trainer now under study. The MT-X is designed to replace the T-33 as well as the T-1. The new trainers will first succeed T-33s, which are expected to be rapidly phased out from 1987. After T-33s are replaced by MT-X's, replacement will shift to T-1s. Intermediate training with T-1s was started by the 13th ASDF Air Training Wing at Ashiya Airbase in 1960. At present, there are more than 50 T-1s. Since they are now 20 years old, new types are required to increase training efficiency. The 20-year old trainers have been exposed to salt corrosion at the coastal airbase. Although careful maintenance has been carried out to prevent corrosion, some items, including the air intake, have been weakened with partial repair required. The coming tests will study how current maintenance measures can prolong the T-1's life. As for performance, the T-1 takes 20 minutes to fly to training space from the airbase, decreasing training time to 30 minutes. The ASDF wants training time to be one hour or more. Therefore, a greater speed and longer range will be major requirements for the MT-X. [Text] [Tokyo JPE AVIATION REPORT-WEEKLY in English 10 Dec 80 pp 7,8]

CH-47-414 TO REPLACE V-107--The Ground Self-Defense Force (GSDF) is expected to select the CH-47-414 as the CH-X to replace the V-107 transport helicopter. This is because the US Army has established arrangements for long-term procurement and maintenance of the CH-47 series. The GSDF's final selection is seen likely before acquisition of two CH-X helicopters for training in FY 1983 or 1984. The FY 1980-84 Medium-Term Defense program envisages procurement of the two training-purpose CH-X's. After taking delivery of the two helicopters, the GSDF plans to procure 45 to 60 CH-X helicopters over seven or eight years with V-107s being phased out from FY 1984 or 1985. The new helicopters will be used for transport of improved Hawk missiles, TOW anti-tank missiles, new long-range 155mm howitzers and other GSDF weapons. [Text] [Tokyo JPE AVIATION REPORT-WEEKLY in English 10 Dec 80 p 8]

CSO: 4120

BRIDGESTONE TO PROMOTE AIRCRAFT TIRE EXPORTS TO U.S.

Tokyo JPE AVIATION REPORT-WEEKLY in English 3 Dec 80 p 1

[Text] Bridgestone Tire Co. will launch full-scale export of aircraft tires to the United States soon as its tires have passed evaluation tests of major American airlines.

It hopes to capture a 30 percent share in the US aircraft tire market with demand for new tires reaching 30,000 per year.

The company started export of aircraft tires to the European market in 1972. Its present European customers include Lufthansa, British Airways, SAS, SABENA, KLM and other major carriers. Its tires are used for large transports such as DC-9s, DC-10s, Boeing 727s, 737s, 747s, and L-1011 TriStars.

Bridgestone obtained a 15 percent share in the European aircraft tire market in 1979. Annual demand totals 25,000.

In 1978, the firm began to deliver aircraft tires to US carriers for evaluation tests covering economic efficiency as well as qualitative aspects. This year, its tires passed tests by United Air Lines, Eastern, Frontier Airlines, and Texas International Airlines, paving the way for full-fledged exports to the United States. Pan American World Airways' tests are still underway.

Bridgestone has FAA-certified testing facilities at its Tokyo Works to ensure its aircraft tires meet American carriers' requirements.

While promoting aircraft tire exports to the United States, it intends to facilitate cooperation with retreading firms.

CSO: 4120

ECONOMIC

TOYO TO EXPORT BEARING THROUGH FAFNIR

Tokyo JPE AVIATION REPORT-WEEKLY in English 3 Dec 80 pp 1-2

[Text] Toyo Bearing Mfg. Co. has agreed with Fafnir Bearing Co., a division of Textron Inc., to extend their technical tie-up contract to sales, enabling its bearings for aircraft to be marketed in Europe and the United States through Fafnir's sales networks.

Toyo introduced aircraft bearing manufacture technology from Fafnir in November 1970. At present, it holds a 60 percent share in the Japanese aircraft bearing market.

The extension of their technical tie-up to sales is in anticipation that the European and US aircraft bearing markets will expand.

CSO: 4120

ECONOMIC

KHI LIKELY TO BE NAMED MT-X PRIME CONTRACTOR

Tokyo JPE AVIATION REPORT-WEEKLY in English 3 Dec 80 p 2

[Text] The Japanese Defense Agency (JDA) is expected to select Kawasaki Heavy Industries (KHI) as prime contractor for development of the MT-X medium jet trainer starting in FY 1982 (April 1982-March 1983), according to industry sources. The selection will come after the JDA's request for funds for design of the MT-X airframe in FY 1981 is approved by the Diet.

Besides KHI, Mitsubishi Heavy Industries (MHI) and Fuji Heavy Industries (FHI) have expressed willingness to be MT-X's prime contractor.

The JDA's move to nominate KHI for the MT-X program has reportedly derived from fear that KHI's aircraft technology would decline in the absence of JDA aircraft orders. Although JDA selected KHI as prime contractor for development of a PX-L antisubmarine patrol aircraft and an airborne early warning system, programs for their domestic development have been dropped. Furthermore, the JDA has suspended orders for KHI's C-1 transports.

Problems are still expected before final selection because MHI and FHI are certain to promote their campaigns.

CSO: 4120

ECONOMIC

MELCO TO EXPAND DEFENSE SYSTEM DIVISION

Tokyo JPE AVIATION REPORT-WEEKLY in English 3 Dec 80 pp 2-3

[Text] Mitsubishi Electric Corp. (MELCO) intends to set up an extensive planning and systems technology group at its new defense systems project office to expand its business in these fields.

The extensive planning group will prepare MELCO's defense systems projects and determine project schedule, while the systems technology group will direct systemization of defense equipment at MELCO's plants and handle requests from the JDA and other customers. About 20 engineers at the defense systems, computer and communications equipment works will be assigned to the two groups. The defense systems project office will also be enlarged.

MELCO's sales to the JDA in FY 1979 totaled ¥53,000 million, indicating a strong foothold in production of electronic and electric defense equipment. Of equipment delivered to JDA during the year, missiles accounted for 40 percent and fire control systems (FCS) 30 percent. The remainder included electronics warfare equipment, radar systems, communications equipment and data processors. Sales to JDA in FY 1980 are expected to increase 10 percent over FY 1979.

MELCO's establishment of the defense systems project office has been prompted by JDA's policy toward modernization and systemization of defense equipment. JDA is expected to follow this policy while reviewing the FY 1980-84 Medium Term Defense Program in FY 1981.

CSO: 4120

TOSHIBA, KHI/NEC COMPLETE PROTOTYPE PORTABLE SAM'S

Tokyo JPE AVIATION REPORT-WEEKLY in English 3 Dec 80 pp 3-4

[Text] Toshiba Corp. and the KHI - Nippon Electric Co. (NEC) group have completed first prototypes of portable surface-to-air missiles (SAM). They will be delivered to the JDA's Technical R&D Institute (TR&DI) at the end of November for evaluation tests. Evaluation results are expected to be known by next February or March.

The TR&DI started research and development of the portable SAM in FY 1979 with completion of development planned for FY 1984. The shoulder-launched missile is designed for air defense of airbases and radar sites.

In FY 1979, the three companies submitted plans to the TR&DI, and Toshiba and the KHI-NEC group were selected to fabricate homing heads and other parts.

The KHI-NEC group has adopted the image homing guidance system to hold down prices, while Toshiba has selected a mixture of image homing and infrared ray homing formulas with priority given to accuracy.

Although the TR&DI originally intended to select one of the two for development, both types are now expected to be adopted for development in consideration of the two contractors' equally competitive technology.

A conspicuous feature of both types is the image homing guidance formula, which Japan has never developed. Under the formula, an image sensor on the head of the missile, like a television camera, detects and tracks a target. The device consisting of 5mm X 5mm CCD elements is as small as the palm of the hand.

The three missile manufacturers claim they have developed the image sensor on their own, although there were foreign advanced guidance systems to copy.

The JDA plans to import foreign portable SAMs with different guidance systems in FY 1981. From 1985, however, it intends to procure domestically developed portable SAMs.

CSO: 4120

ECONOMIC

INDUSTRY URGES GOVERNMENT TO EASE ARMS EXPORT BAN

Tokyo JPE AVIATION REPORT-WEEKLY in English 3 Dec 80 pp 4-5

[Text] The Electronics Industries Association of Japan (EIAJ) will urge the Japanese government to lift its export ban on arms to countries other than those involved in conflicts, a spokesman for EIAJ said last week. Presently the government bans export of all Japanese made military equipment.

The statement is considered to be the industry's answer to a Democratic Socialist Party member of the House of Representatives who has claimed that a Japanese developed short-range surface-to-air missile coded here as the Tan-SAM costs more than the Roland missile adopted by France and Germany as well as the United States.

High costs of the Japanese developed weapons are mainly attributable to the fact that they are developed and produced for the Japanese Self-Defense Forces only, and that the quantity of each item required by the SDF is limited, he said. The government should allow the industry to export Japanese military equipment so that it can compete with foreign products on an equal basis, and this competition would help reduce the prices of Japanese made arms, he added.

The industry should, nevertheless, abide by the Export Control Law which forbids sales of arms to communist countries, and those to which export of arms is prohibited by resolutions of the United Nations, as well as to those involved or liable to be involved in conflict, the association maintains. In February 1976, then Prime Minister Takeo Miki practically banned export of all military equipment to any country.

EIAJ is expected to officially sound out the government and Liberal Democratic Party after consulting with top leaders of the Defense Production Committee of the Federation of Economic Organizations, Japan Ordnance Industry Association and the Society of Japanese Shipbuilders.

EIAJ does not believe the government will easily lift the arms export ban, but plans to create a general atomosphere where matters related to development and production of military equipment can be debated more openly, industry sources say.

CSO: 4120

SJAC TO PARTICIPATE IN 1981 PARIS AIR SHOW

Tokyo JPE AVIATION REPORT-WEEKLY in English 10 Dec 80 p 3

[Text] The Society of Japanese Aerospace Companies (SJAC) has decided to join in the 34th Paris Air Show June 4-14 next year, calling on member companies to exhibit products at the air show.

It will start full-scale preparations for participation with shipment of exhibits planned for the end of next March. SJAC Chairman Eiichi Ohara will also attend.

SJAC's purpose is to expand the Japanese aerospace industry's trade with foreign countries in view of the importance of international aerospace cooperation. It wants to publicize Japanese industry and promote international interchange and exchange of information.

It will give priority to company-by-company exhibits as well as overall exhibits to expand sales, introduce Japanese industry ability, and step up foreign appreciation of Japanese products.

At the show, SJAC plans to use 20 to 23 indoor booths for exhibits and a 72-square-meter single chalet for entertainment.

SJAC's conceivable exhibits include vendors' products, RJ500, FJR and other aeroengines, products of airframe manufacturers, and introduction of the space industry and airlines.

CSO: 4120

CTDC COMMISSIONS FIVE FIRMS TO STUDY FOUR 767 COMPONENTS

Tokyo JPE AVIATION REPORT-WEEKLY in English 10 Dec 80 pp 3-4

[Text] The Civil Transport Development Corp. (CTDC) has concluded contracts worth ¥60 million with five companies for development and testing of four components of the Boeing 767 in FY 1980.

The five firms are Yokohama Rubber Co., Hokushin Electric Works Ltd., Tokyo Koku Keiki Co., IHI, and Sumitomo Precision Products Co.

Development and tests of the four components have been conducted since FY 1979. The four components and their past development and test results follow:

(1) Honeycomb sandwich structure items (Yokohama Rubber): An appropriate fiber combination was chosen for developing the preplug designed to set at 250 degrees Fahrenheit. The preplug was fabricated for evaluation tests.

(2) Inertial navigation system (Hokushin Electric, Tokyo Koku Keiki): A navigational computing component for a strapdown inertial navigation system was designed, while a device using a microcomputer was fabricated. Evaluation and environmental tests were conducted on angular velocity and acceleration sensors with improved accuracy and stability.

(3) Aircraft integrated data system (AIDS) (IHI): Measures were studied to demonstrate engine data analysis technology vital to the engine AIDS system.

(4) Ultrahigh tension steel landing gear (Sumitomo Precision): Computers were used for analyzing a rough runway taxiing load and shock absorbers' performance, which have a major relation to landing gear design. Material tests involved 300M steel.

CSO: 4120

KHI'S MISSILE SALES TO REACH ¥5,000 MILLION IN FY '82

Tokyo JPE AVIATION REPORT-WEEKLY in English 10 Dec 80 pp 4-5

[Text] Sales of Kawasaki Heavy Industries Ltd. (KHI) missile division are expected to increase from the current ¥3,000 million yearly to ¥5,000 million in FY 1982 due to mass production of the Model 79 antiship/tank missile, codenamed "Ju-MAT" by KHI, as well as JDA orders for research related to portable surface-to-air missiles (SAM).

Although KHI developed the Model 64 antitank missile in 1964 as Japan's first domestically developed missile, its missile division sales have been less than Mitsubishi Electric Corp. and other firms manufacturing missiles under license.

Together with increasing Ju-MAT production, however, development of various new missiles planned by JDA could sharply expand KHI's missile business in the decade starting in 1985.

On the portable SAM, KHI has formed a group with Nippon Electric Co. (NEC) in order to win the JDA development contract.

KHI has also been named prime contractor for development of a medium-range antitank missile using a laser homing guidance system.

One problem in missile development projects is which company(s) KHI should select as its partner(s) undertaking electronics systems.

Although KHI has so far formed a group mainly with NEC for missile projects, including the Ju-MAT, it has participated in Tan-SAM short-range missile development as a subcontractor of Toshiba Corp. which is the prime contractor. KHI says its cooperation with Toshiba will increase in the future.

KHI has so far developed and produced mainly antitank missiles, monopolizing domestic production of such missiles. With the portable SAM project, however, it wants to extend its missile field to SAMs.

CSO: 4120

IHI TO TEST T56, F100 PARTS FOR LICENSE PRODUCTION

Tokyo JPE AVIATION REPORT-WEEKLY in English 10 Dec 80 pp 5-6

[Text] Ishikawajima-Harima Heavy Industries (IHI) will start the first tests of engine parts for the P-3C aircraft and the F-15 fighter in early 1981 to obtain license production certification.

Tests of about 200 parts of the T56 for the P-3C will begin in January, while tests covering about 200 parts of the F100 for the F-15 will start in February or March.

The Japanese Defense Agency (JDA) ordered 12 T56 engines in FY 1978. Of them, 10 engines will be equipped with IHI-produced parts. The first will be delivered from December 1981. IHI will produce 790 components, including those for the coming tests, of the 1,042 in each engine.

The JDA's F-15 order in FY 1978 involved 32 F100 engines, of which two have already been acquired by IHI. The remaining 30 engines are eight for knockdown production and 22 for partial license production. Of the 1,418 items per engine, IHI's license production will cover 1,052, including those for the coming tests. Delivery of the first F100 with IHI-produced items will start in October 1981.

More F100 parts were subjected to IHI's license production at Japan-US governmental negotiations last summer, in which the Japanese side requested an increased domestic production share for the F-15. Certification tests of the additional components will be conducted as quickly as possible.

Of the 12 ordered T56 engines, four will be delivered in December 1981, two in January 1982, two in February and four in March.

Two F100 engines for testing were delivered at the end of FY 1979. Eight engines for knockdown production will be delivered between April and June 1981. Delivery of the remaining 22 will be from October 1981 to August 1982.

CSO: 4120

ECONOMIC

AIRBUS PROPOSING JAPAN JOIN SA PROGRAM AS EQUAL PARTNER

Tokyo JPE AVIATION REPORT-WEEKLY in English 10 Dec 80 pp 6-7

[Text]

Bernard Lathiere, President of Airbus Industrie, told a press conference in Tokyo last Wednesday that the European consortium is proposing that the Japanese aircraft industry join its Single-Aisle (SA) Aircraft Program as an euqal partner.

After explaining details of the present status of his organization and prospects of current and future aircraft programs, such as development versions of the A300 which Toa Domestic Airlines will begin using very soon and its smaller brother, the A310, he went on to say that Airbus Industrie plans to begin development of the SA series narrow-body twin-engine aircraft in about one year, and that it is scheduled to enter airline service toward the end of 1985 or early 1986.

Lathiere said that the consortium is proposing Japan join the SA program from the early design stage to development, production and marketing on an equal basis. Airbus Industrie is seeking Japan's cooperation not as a mere subcontractor but as a full partner, he emphasized. "We would like to continue this partnership into our next generation," he said.

The SA series aircraft which Airbus Industrie is proposing for joint development will be a brand new airliner incorporating new technology. It will be designed to replace such present narrow-body aircraft and its derivatives as the Boeing 727-200, 737-300, and various types of the McDonnell Douglas DC9 including the Super 80.

The SA, which will take advantage of the experience gained on the A300 and A310, will have commonality in many areas with both aircraft, using the latest advances in terms of aerodynamics and structure (use of composite materials), digital systems and cockpit instruments. It will offer high performance standards particularly for operation out of short, hot-and-high airfields, low fuel consumption, low noise, high standards of passenger comfort and good cargo capability, and of course lower operating costs than competitive aircraft, Latiere stated.

Lathiere also told the press that the cooperation between Japanese manufacturers and Airbus Industrie in the new aircraft program will certainly help improve the trade relations between Japan and the EC countries.

Asked about the organizational setup for promotion of the SA program with Japan, Lathiere replied that establishment of a new policy board may be considered for the program, but that the present efficient management setup should continue to be maintained. Further discussions will, however, be made on this matter, he added.

Concerning the marketing of the SA aircraft, Airbus Industrie is not considering division of sales territory by participating companies. "A single sales organization is the best as this has been proven with the sales of the present A300 and the A310," Lathiere said.

CSO: 4120

ECONOMIC

BCAC OFFICIAL IN TOKYO FOR TALKS ON Y-XX

Tokyo JPE AVIATION REPORT-WEEKLY in English 17 Dec 80 pp 1-2

[Text] T. J. Backer, Director - International Business, Boeing Commercial Airplane Co. (BCAC), was in Tokyo recently for talks with top executives of the Japanese aircraft industry on issues related to development of new medium-size aircraft coded here as the Y-XX program.

As a member of BCAC's special committee conducting feasibility studies on new aircraft, Backer reportedly exchanged opinions with Japanese industry leaders as part of Boeing's efforts to expand its business relations with the Japanese aerospace industry which is already committed to the 767 program.

Although recent talks helped promote mutual understanding between the two parties, the American company, busy on the 757 program and studies on the 737-300 project, was very cautious on the Japanese Y-XX program, according to local industry sources.

On the other side, the Japanese industry has to make up its mind about its basic stance toward the Y-XX soon in order to have preliminary survey funds approved in the cabinet draft of the FY 1981 national budget request which is scheduled to be finalized toward the end of December.

CSO: 4120

BRIEFS

UAE SWITCHBOARD ORDER--Tokyo 16 Dec KYODO--Fujitsu, Ltd. said Tuesday it has received a yen 600 million order for 100 systems of electronic private branch exchanges (EPBX) known as "Fetex 400" from United Arab Emirates' Emirates Telecommunications Corp. (EMIRTEL). Fujitsu said that the UAE has decided to introduce the systems as part of its policy to accelerate its domestic economy. It underbid the world's 13 makers, including Siemens A.G. of West Germany, Ericsson Telephone Co. of Sweden and Plessy Co. of Britain in an international bidding held last May. The deal was negotiated through Toyo Menka Kaisha, Ltd. (Tomen), Japan's seventh largest general trading house. [Text] [OW190133 Tokyo KYODO in English 0539 GMT 16 Dec 80]

LIBYAN STEEL MILL CONTRACT--Tokyo 18 Dec KYODO--Libya has awarded Japanese firms cash-on-delivery contracts for construction of steel mills in Misurata, east of Tripoli, capping years of marathon negotiations, sources said Thursday. A Japanese-Mexican consortium, led by Kawasaki Heavy Industries Ltd., has landed a yen 90 billion (about dollar 430 million) contract to build two 550,000-ton-a-year direct-reduction iron mills, after underbidding the Korf group of West Germany and other companies. The contract is expected to be signed in Tripoli shortly. The mills, based on technology developed by Mexico's Hylsa, will be powered by locally abundant natural gas. They are designed to serve as the core of the Misurata Integrated Steel Complex. The Libyan Government-owned corporation for iron and steel projects has also selected the group of Kobe Steel Ltd. and Mitsui and Co. as the successful bidder for construction of steel bar, wire rod and shape mills and water treatment and other related facilities for the steel complex. This contract is valued at yen 160 billion (dollar 760 million). The bar and wire rod mill will have an annual capacity of 400,000 tons and another mill will be capable of producing 120,000 tons of shapes and beams annually. The Mammoth Steel Complex, with an annual capacity of 1.26 million tons, is estimated to cost the equivalent of yen 700 billion (dollar 3.3 billion). [OW190133 Tokyo KYODO in English 0553 GMT 18 Dec 80]

PRC MARGARINE PLANT--Tokyo 17 Dec KYODO--Sakura Seisakusho Ltd. of Osaka disclosed Wednesday it had signed a contract to build China's first integrated margarine and shortening plant. The contract with the Beijing branch of the China National Machinery Import and Export Corporation calls for the plant to be completed by next May. The Japanese company will also provide margarine and shortening production know-how to the Beijing Food Industry Research Institute. Value of the deal was not disclosed. [Text] [OW190133 Tokyo KYODO in English 0302 GMT 17 Dec 80]

SINGAPORE COMPUTER CENTER--Singapore 18 Dec KYODO--Japan Thursday signed a document with Singapore to establish a joint computer center to train Singaporeans in software technology. Japan will supply 3 million Singapore dollars (yen 300 million) worth of computers and send 6 experts to the center and also train 20 Singapore students in Japan. [Text] [OW190133 Tokyo KYODO in English 1245 GMT 18 Dec 80]

ASEAN FERTILIZER CONTRACT--Tokyo 16 Dec KYODO--Toyo Engineering Corp. said Tuesday that it had signed a yen 70 billion contract to supply a major fertilizer plant to P.T. ASEAN Aceh Fertilizer, a fertilizer firm jointly owned by five members of the Association of Southeast Asian Nations (ASEAN) countries. The plant is the first project involving the ASEAN, grouping Indonesia, the Philippines, Thailand, Malaysia and Singapore, to head for materialization. The plant with a daily production capacity of 1,000 tons of ammonia and 1,725 tons of urea is expected to be completed in the first quarter of 1984 at Lhokseumawe, in Aceh. The projected fertilizer plant in Indonesia will be financed by the two Japanese governmental financial institutions, Overseas Economic Cooperation Fund and the Export-Import Bank of Japan. [OW190133 Tokyo KYODO in English 0755 GMT 16 Dec 80]

AID TO HONDURAS--Tokyo 17 Dec KYODO--Japan will extend grant aid of up to yen 300 million to Honduras for a project to increase production of corn and beans under notes exchanged in Teguciagalpa Tuesday between Japanese ambassador Kenji Ishikawa and Cesar Elvia Sierra, foreign minister of Honduras, the foreign minister said Wednesday. It said extension of the grant aid was requested by the Honduras Government to secure agricultural machinery necessary for implementation of the project. [Text] [OW190133 Tokyo KYODO in English 0203 GMT 17 Dec 80]

AID TO THE GAMBIA--Tokyo 20 Dec KYODO--Japan will provide the Gambia with a grant totaling yen 210 million to buy American wheat, the foreign ministry said Saturday. Notes to this effect were exchanged Friday in Banjul by Japanese ambassador to the Gambia Sonoo Uchida and Lamin Kiti Jabang, external affairs minister of the Gambia, officials said. The West African state is predominantly agricultural, producing groundnuts as the major source of its foreign exchange revenue. But, production has declined, due to the repeated droughts, the officials said. [Text] [OW230013 Tokyo KYODO in English 0520 GMT 20 Dec 80]

AIR AGREEMENT WITH FINLAND--Tokyo, 24 Dec KYODO--Japan and Finland agreed to establish direct air service between the two countries, the foreign ministry announced Wednesday. The agreement was signed in Helsinki Wednesday between Japanese Ambassador Koichiro Yamaguchi and Matti Tuovinen, secretary general of Finnish Ministry of Foreign Affairs. The flow of passengers and goods between the two countries has increased recently as bilateral trade and other economic relations expanded. Finnair plans to operate one flight weekly from next April, but Japan Air Lines has no plan to commence the service in the near future. [Text] [OW241039 Tokyo KYODO in English 0827 GMT 24 Dec 80]

AID TO HAITI--Tokyo, KYODO--Japan will provide Haiti with up to yen 300 million in aid for its increased food production. Notes to this effect were exchanged Wednesday (Japan time) in Port-au-Prince between Tokuya Shinmura, Japanese charge d'affaires ad interim, and Georges Salomon, minister for foreign affairs and worship of the Caribbean country. The sum will be used for a five-year program to increase food production. [Text] [OW241039 Tokyo KYODO in English 0906 GMT 24 Dec 80]

AID TO PHILIPPINES--Tokyo, 24 Dec KYODO--Japan and the Philippines exchanged notes Wednesday on yen 2,000 million (about dollar 9.5 million) grant aid designed to increase the later's food production, the foreign ministry said. A ministry spokesman said the notes were exchanged in Manila between Japanese Ambassador Hideo Tanaka and Philippine Foreign Minister Carlos Romulo. The grant will be used to purchase fertilizer, agricultural chemicals and machinery, the spokesman added. [Text] [OW241039 Tokyo KYODO in English 0924 GMT 24 Dec 80]

YEN LOAN TO INDONESIA--Tokyo 23 Dec KYODO--Japan will provide Indonesia with a yen 58 billion loan during the current fiscal year ending in March 1981 under an agreement concluded in Jakarta Tuesday, the government announced. The loan, repayable over a period of 30 years, including a 10-year grace period, at an annual interest of 2.5 percent, will be used for hydro power plant construction, port and harbor repair and other development projects. The government said the agreement also called for disbursement of yen 28.2 billion loans to Indonesia left over from earlier agreements due to delays in development which were to be covered by such loans. [Text] [OW230501 Tokyo KYODO in English 0424 GMT 23 Dec 80]

REFUGEE AID FOR THAILAND--Tokyo, 23 Dec, KYODO--Japan will donate yen 300 million to Thailand for various relief activities for Kampuchean refugees, the foreign ministry said Tuesday. The ministry said the Japanese Government has decided on the aid in response to the Thai request. This brings to yen 3,200 million the total amount of money Japan extended to Thailand in the current fiscal year in support of the country's refugee relief program, according to the ministry. [Text] [OW230501 Tokyo KYODO in English 0649 GMT 23 Dec 80]

AID TO SIERRA LEONE--Tokyo 23 Dec KYODO--Japan will extend to Sierra Leone food aid up to yen 200 million in rice and a grant aid up to yen 300 million, the foreign ministry said Tuesday. Notes on the aid were exchanged in Freetown Monday by Japanese Charges d'Affaires Hiroshi Funakoshi and Sierra Leone Foreign Affairs Minister Abdulai Conteh. The yen 300 million grant aid will cover the cost of transporting the rice to the African country, the foreign ministry said. In fiscal 1979, which ended last March, Japan extended to Sierra Leone a food aid in rice valued at dollar 1,020,000 including dollar 22,000 in transportation costs. [Text] [OW230501 Tokyo KYODO in English 0309 GMT 23 Dec 80]

ARGENTINE STEEL PROJECT INVESTMENT--Buenos Aires, 24 Dec, KYODO--Japan has formally told Argentina that its government and private businesses are ready to invest jointly in the Argentine project to expand its state-run steelworks, the Japanese Embassy here said Wednesday. Contents of the notification were not disclosed. According to informed sources, however, the Japanese Government will pay 20 percent of dollar 50 billion asked to be invested in the new equipment and expansion work at the steelworks--Sociedad Mixta Siderurgia Argentina (SOMISA). Argentina called for the Japanese cooperation with the project when its president, Jorge Rafael Videla visited Japan in October last year. The Latin American country at first asked Japan to invest a total of dollar 200 billion in the project. But the amount was later reduced to dollar 50 million. Argentina is expected also to ask West Germany for financial support for the project. [Text] [OW261453 Tokyo KYODO in English 0100 GMT 25 Dec 80]

SHISEIDO TOILETRIES IN PRC--Tokyo, 26 Dec, KYODO--Shiseido Company, Japan's top maker of cosmetics, announced Friday it would begin to sell its toiletries in China next February. The company said it recently signed an agreement on the marketing of its products in China with the Beijing branch of the China National Light Industrial Products Imports and Export Corporation. It said it was the second foreign concern to penetrate the Chinese cosmetic market after Max Factor of the United States. China asked the company to sell its toiletries at hotels in Beijing and other cities, it added. Under present plans, Shiseido will initially sell about 50 products in China, it added. [Text] [OW261453 Tokyo KYODO in English 1025 GMT 26 Dec 80]

BANK OF CHINA AGREEMENT--Tokyo, 16 Dec (JIJI PRESS)--Bank of Tokyo Tuesday announced it has concluded a business cooperation agreement with the Advisory and Trust Department of Bank of China, the sole foreign exchange bank in that country. The accord calls for, among others, introduction of business customers. The department will arrange for compensation (production sharing) trade, processing trade and joint ventures by introducing funds from abroad--business that has so far been undertaken by China International Trust and Investment Corp. Under the agreement, the two banks will also exchange information on those fields of business and cooperate in surveys and fund raising. [Text] [OW170257 Tokyo KYODO in English 1355 GMT 16 Dec 80]

CSO: 4120

INDUSTRIAL TECHNOLOGY DEVELOPMENTS DETAILED

Aircraft Industry

Tokyo KOGYO GIJUTSU in Japanese Vol 21, No 6, Jun 80 pp 20-27

[Article by the Aeronautical Weapons Section, Machinery and Information Industries Bureau, MITI]

[Text] 1. Significance and Special Features of the Aircraft Industry

After the war, Japan's economy accomplished an advanced growth unparalleled in the world and many industries were developed in the process with some of them achieving world standards. The automobile, steel, shipbuilding and electrical industries are some of the representative ones.

As for the aircraft industry, its standards in pre-war days were world ranking, but production was banned after the war for 7 years during which period the world trend in the industry was on jet conversion, and as a result of her late resumption in production, Japan lagged far behind the U.S., Great Britain, France, etc., and this gap situation has remained unchanged today.

The chief causes of this situation are as follows:

First, the aircraft industry is a technology-intensive industry that requires the most advanced in technological sophistication, but the fact is that, because of the technological innovation brought about by jet conversion, the technological difference between Japan and the Western countries was almost insurmountable. Second, although progress of the aircraft industry and the development of aircraft are supportive of each other, the development of one type of aircraft requires a vast outlay of capital and because it meant competing against big business of the Western nations for the world market, the business risk was heavy and therefore it was not easy to consider undertaking aircraft development. Third, the defense budget on aircraft was very small when compared with that of the Western nations and because the development projects on the Defense Agency's aircraft were few in number, much could not be expected as technological spinoffs from the Defense Agency aircraft. Fourth, the aircraft industry is a composite industry only after the various phases and facets that include materials and components are integrated, but in Japan the ancillary industries were too weak.

However, the aircraft industry is a representative knowledge-intensive industry that has a high rate of additional value and a far-reaching technological effect. This fact is borne from the following comparisons: the value of the unit weight (per ton) of the transport aircraft is 80 million yen while that of the aircraft engine is 140 million yen; others are electronic computer, 30 million yen; color TV, 5 million yen and automobile, 900 thousand yen. (Figure 1)

Key:

(1) Value per unit weight (1 million yen/ton)
(2) Aircraft engine
(3) Transport aircraft
(4) Camera
(5) Electronic computer
(6) Color TV
(7) Automobile
(8) Shipbuilding
(9) Compiled by the Civil Transport

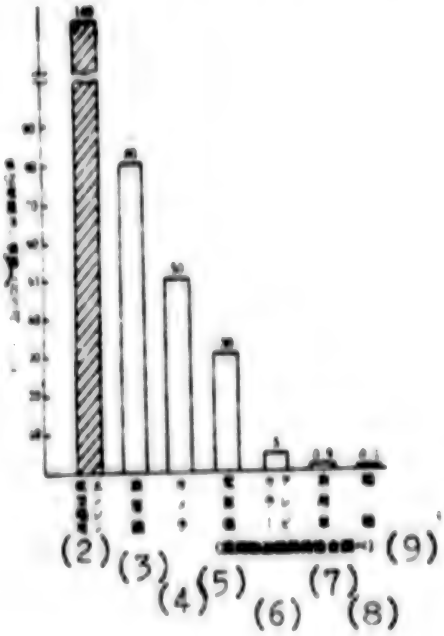


Figure 1. Comparion of Values Per Unit Weight (1975)

Even the rate of additional value is very high: transport aircraft, 44 percent; aircraft engine, 48 percent; electrical equipment, 37 percent; iron and steel, 28 percent and automobile, 24 percent. (Figure 2)

Key:

(1) Net value rate (%)
(2) Aircraft engine
(3) Aircraft
(4) Machiner
(5) Shipbuilding
(6) Electrical
(7) Iron and steel
(8) Automobile

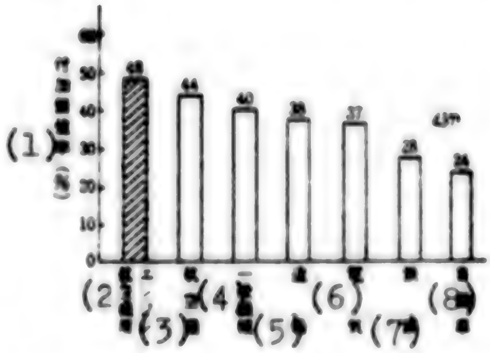
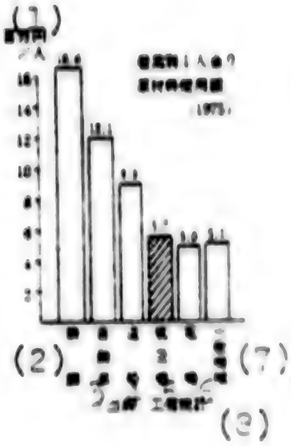


Figure 2. Comparison of Addition Rates by Industries (1974)
Additional Value Rate=Net Additional Value Total/Production Total

Also, for the amount of raw materials, including fuel, used per capita in the aircraft industry, it is about one-third of that for the iron and steel industry and about one-half of that for the automobile industry. (Figure 3)



Key:
(1) 1 million yen per person
(2) Iron and steel
(3) Autombile
(4) Shipbuilding
(5) Aircraft
(6) Electrical
(7) Machinery
(8) (Source: Industrial Statistics)

Figure 3. Amount of Raw Materials Used per Capita by Industries (1972)

These figures indicate the high technological intensiveness of the aircraft industry, the tremendous employment opportunities it offers and an industry that conserves materials and saves energy. Furthermore, the aircraft industry extends its influence over a wide spectrum of industries, such as materials, electronic equipment, processing machine tools, etc., and its technological leadership is foremost. (Figure 4)

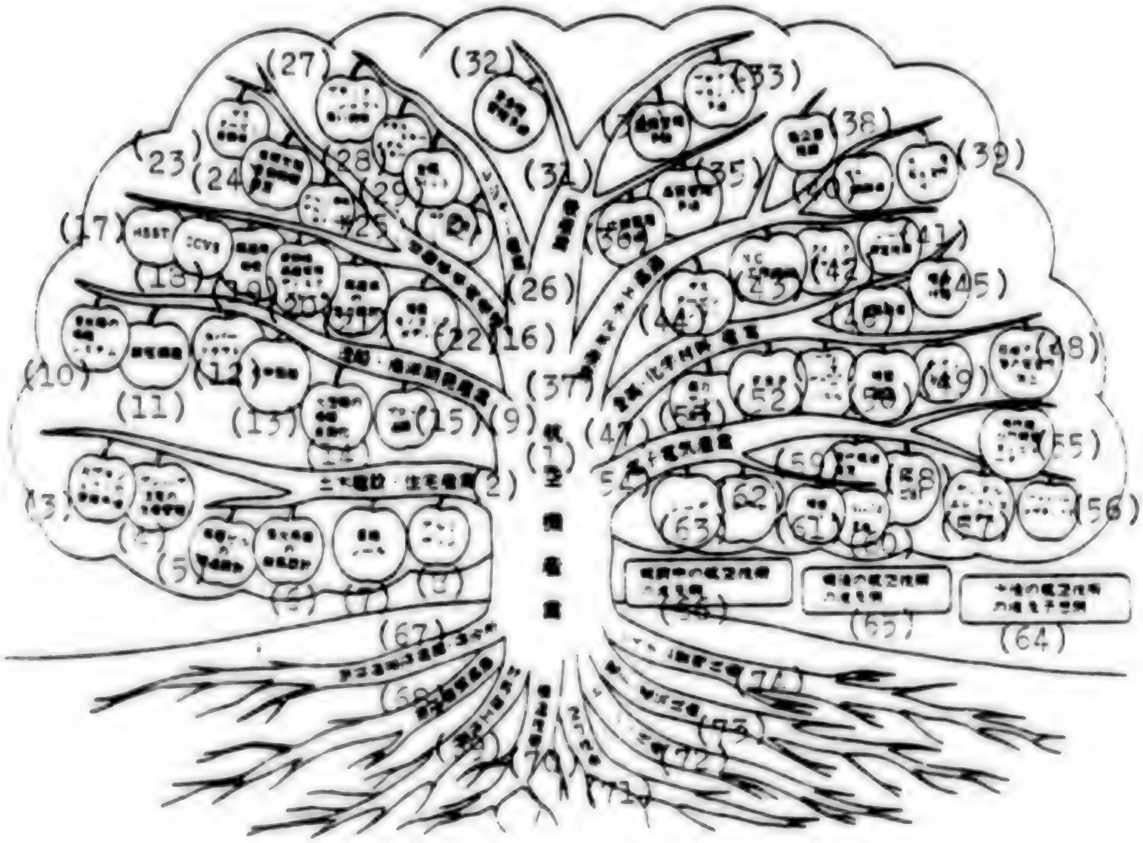


Figure 4. Far Reaching Effect of Aircraft Industry

[Key on following page]

[Key to Figure 4 on preceding page]

(1) Aircraft industry
(2) Building, construction, housing industry
(3) Management methods with large projects
(4) Production management of prefab housing
(5) Structural design of high rise buildings
(6) Windproof design of long, large suspension bridge
(7) Joint seal
(8) Aluminum sash
(9) Shipbuilding and oceanographic development industry
(10) Steering system of underwater craft
(11) Pressure-proof structure
(12) Hovercraft
(13) Aquatic winged ship
(14) Automated pilot boat of large size ship
(15) Block shipbuilding
(16) Automobile industry
(17) HSST
(18) CCUS
(19) High speed bearing
(20) Bullet express train high speed disk brake
(21) Aerodynamic design of high speed car
(22) Lightweight monocoque body
(23) Gas turbine automobile
(24) Automated diagnosis apparatus for vehicle defects
(25) Aluminum body and aluminum wheel
(26) Travel industry
(27) Black shaft; black pole
(28) Glass ski; metal ski
(29) Metal butt
(30) FRP boat
(31) Industry in general
(32) Safety management methods
(33) Program management method
(34) Maintenance management method
(35) quality control method
(36) Specifications control method
(37) Machinery energy industry
(38) Low pollution technology
(39) Increased safety of nuclear power general
(40) Plant automatic control
(41) Laster measuring technology
(42) Quick fastener
(43) N. C. machine tools
(44) Gas turbine engine
(45) Composite material
(46) Metal soldering
(47) Metal and chemical materials industry
(48) Increased safety of petroleum tank, etc.
(49) Titanium alloys
(50) Precision forging
(51) Honeycomb panel
(52) FRP
(53) High strength aluminum alloy
(54) Electronics and electrical industry
(55) High performance, small type lightweight computer
(56) Fiber optics
(57) Digital electronics
(58) IC LSI
(59) Inertial flight device
(60) Ni-Cd battery
(61) Precision gyro
(62) Loran
(63) Radar
(64) Forecast on the spread of the future aeronautics industry
(65) The spread of the post-war aeronautics industry
(66) The spread of the wartime aeronautics industry
(67) Safety and reliability management technology
(68) Machinery control technology
(69) Materials processing technology
(70) Structural technology
(71) Aeronautics technology
(72) Engine technology
(73) Electronics and electrical technology
(74) Systems control technology

As described above, the aircraft industry is representative of a knowledge-intensive industry and it is expected to play an important role in seeking to upgrade Japan's industrial structure in the future, and it must seek greater progress hereafter.

2. The Present State of Japan's Airacrft Industry

(1) Size of Japan's Aircraft Industry

The annual sales of Japan's aircraft industry have been more than 100 billion yen, more than 200 billion yen in 1975 and about 280 billion yen in 1978. (Table 1) The average increase rate for the past 10 years has been 11.7 percent which can be considered to be a steady growth.

Table 1. Actual Production Output of the Aircraft Industry

(1)	(4)	(5) (6)	(7)	(8)	(9)	(10) (11)	(12)	(13) (14)	(15)	(16)
(2) 27	0.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(3) 28	26.3	0	22.4	3.1	0	20.9	3.6	4.2	0.6	19.5
29	28.1	4.3	14.7	4.4	0.7	13.6	10.5	13.4	2.1	8.6
30	30.0	16.1	10.6	3.3	0	16.4	13.6	19.6	5.2	6.1
31	42.5	23.9	14.5	3.2	0.9	23.4	19.1	26.4	6.5	9.5
32	100.6	75.1	19.6	5.6	0.3	72.7	27.9	73.6	8.4	19.4
33	188.3	143.6	21.0	16.6	6.9	154.6	33.7	123.2	11.2	53.9
34	186.6	153.0	14.7	15.7	3.2	149.2	37.4	101.9	17.8	67.0
35	248.4	213.1	36.0	18.1	0.2	184.7	63.7	141.2	30.0	77.2
36	271.9	[illegible]	17.2	[illegible]	0	179.9	91.9	135.2	33.3	103.3
37	365.1	239.6	20.0	62.9	2.5	260.2	104.9	166.3	67.2	131.7
38	609.8	496.0	24.0	60.8	14.2	497.6	112.0	268.6	126.3	214.7
39	629.3	[illegible]	19.6	63.2	18.4	633.1	95.1	336.5	130.1	264.7
40	[illegible]	[illegible]	18.0	116.1	5.8	438.6	111.8	251.3	66.3	232.0
41	530.5	343.9	32.6	124.8	29.2	389.4	141.1	197.9	74.7	252.9
42	780.7	486.5	37.0	167.6	87.7	601.9	180.9	354.8	92.2	341.0
43	922.2	486.4	49.2	219.7	173.9	724.6	197.5	426.7	103.7	391.9
44	983.9	530.1	57.4	268.7	128.7	776.9	207.0	472.9	119.5	443.5
45	1 103.1	709.2	46.5	286.3	60.7	889.6	213.5	442.8	150.0	509.7
46	1 113.9	784.0	37.8	213.6	66.5	906.0	207.9	399.6	180.8	533.5
47	1 348.8	1 091.8	28.8	142.0	86.2	1 151.5	197.3	473.1	251.4	624.3
48	[illegible]	1 469.5	17.3	147.6	122.6	1 551.6	205.4	642.6	303.7	810.7
49	1 994.3	1 734.7	12.2	173.4	74.0	1 757.0	237.3	653.9	331.5	980.9
50	2 392.9	[illegible]	12.5	235.6	67.1	2 109.5	283.4	842.8	460.8	1 089.3
51	2 501.0	2 212.4	12.2	220.7	49.7	2 166.4	334.6	934.4	539.8	1 026.7
52	2 598.2	2 301.6	12.0	221.3	63.3	2 218.3	379.9	922.8	546.1	1 129.3
53	2 782.2	2 404.0	13.4	279.4	97.4	2 340.8	432.4	946.9	572.1	1 274.2
(17)	24 286.6	19 222.4	626.5	3 147.6	1 294.1	20 231.1	3 989.5	9 315.7	4 252.3	10 632.3
(18)	100	79.4	2.6	13.0	5.0	83.6	16.4	38.5	17.6	43.9

Unit value: 100 million yen
Source: Survey and Statistics Section, MITI; however, the breakdown by demand until 1961 is based on survey by The Society of Japanese Aircraft Contractors

Key:
- (1) Showa year designation
- (2) 27=1952
- (3) 28=1953
- (4) Production output
- (5) Breakdown by demand
- (6) Defense Agency
- (7) U.S. armed forces
- (8) Domestic demand
- (9) Exports
- (10) Breakdown by operations
- (11) Manufacturing
- (12) Repair
- (13) Breakdown by functions
- (14) Airframe
- (15) Engines
- (16) Equipment
- (17) Total
- (18) Breakdown by percentages

But in comparison with other industries, it is about one-forty seventh of that for the iron and steel industry, one-forty fourth of that for the automobile industry and one-twenty second of that for home electrical products industry; in other words, its size is very small.

In comparison with the leading nations of the world, it is about one-twentieth of that for the U.S., one-fourth of that for France and Great Britain, and one-half of that for Germany. Like Italy, Japan falls in the so-called fourth group. (Table 2) In terms of GNP percentage, it is 1.8 percent for the U.S. and 1.6 percent for Great Britain while it is 0.17 percent for Japan, and the present situation is that Japan is the lowest among the leading nations of the world.

Table 2. Comparison of Sales with Foreign Countries (1978)

Unit value: 100 million yen

Countries	Aircraft	Engine	Space	Mounted	Totals	Remarks
U.S.	30,493	8,810	17,732	7,295	64,330	
Canada	803	762	--	391	1,956	Space data unknown; not included in total
Great Britain	4,121	3,798	202	2,788	10,908	
W. Germany	6,378	*	632	*	7,010	Data included in aircraft section
France	5,843	2,995	--	2,355	11,193	Space data unknown; not included in total
Holland	686	0	73	68	827	
Italy	1,505	397	69	236	2,207	
Spain					187	Breakdown unknown
Japan	1,698	572	(719)	523	2,793	Space data is approximate for FY 1978 and is not included in the total

The number of employees was 20,000 in 1961 and 28,000 in 1970. There was a decrease to 24,000 in 1977, but with the initiation of the next-generation civil transport (YX) plan plus an increase in defense demands, there was a slight increase to 25,000 in 1978. This figure compared with those of the leading nations of the world indicates that it is about one-thirtieth of that for the U.S., one-eighth of that for Great Britain and one-fourth of that for France. (Table 3)

(2) Demand Configuration and Industry Configuration

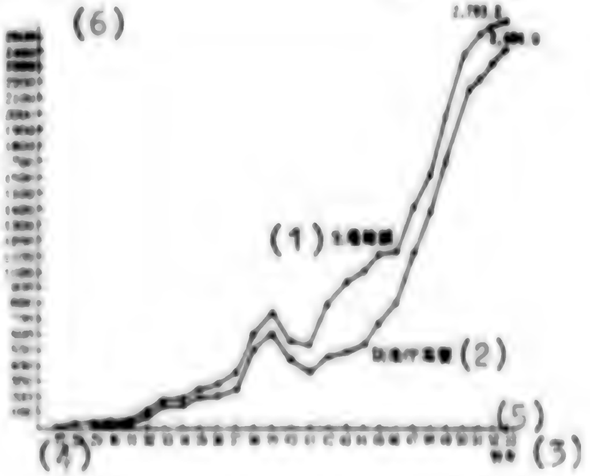
As for the demand configuration (Figure 5) of Japan's aircraft industry, on the basis of the production outputs during the years from 1952 to 1978, the total during the period amounted to 2.42 trillion yen as against the Defense Agency's demand total of 1.92 trillion yen or 79 percent. This figure would reach 82 percent if the U.S. military's special procurement (overhaul, etc., of U.S. military aircraft) is included.

Table 3. Comparison of Employees with Foreign Countries (1978)

Countries	Aircraft	Engine	Space	Mounted Equipment	Totals	Remarks
U.S.	398,000	131,000	83,000	131,000	743,000	
Canada	17,100	10,700	--	6,000	33,800	Space data unknown; not included in total
Great Britain	80,600	63,600	3,200	70,400	217,800	
W. Germany	34,974	7,946	3,111	12,969	59,000	
France	58,760	22,415	--	22,825	104,000	" "
Holland	5,300	--	180	1,920	7,400	
Italy	21,900	5,500	500	4,900	32,800	
Spain					8,000	Breakdown unknown
Japan	13,510	4,553	--	7,335	25,398	Breakdown is estimated according to FY 1977's gross industrial [output] table

Figure 5. Aircraft Industry's Production and the Defense Agency's Demands

Key:
- (1) total production
- (2) defense agency's demands
- (3) Showa year designation
- (4) 27 = 1952
- (5) 53 = 1978
- (6) Unit value = 1 billion yen

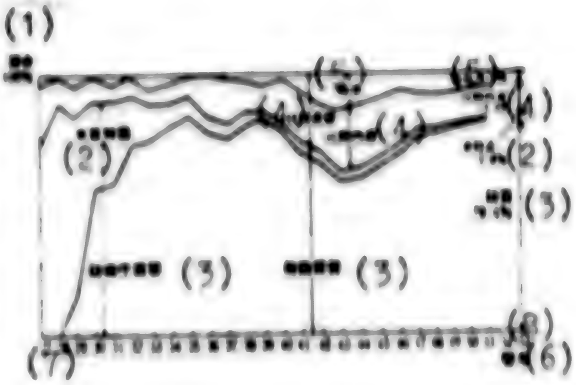


The defense demand including the U.S. military's special procurement showed a value of about 90 percent right after the resumption of the aircraft industry in 1952, but with the stepped-up activity in the production of such civil aircraft as the YS-11 and MU-2, its value dropped to 57 percent in 1968; thereafter, it continued to increase and reached the high percentage of 87 percent in 1978. (Figure 6).

As for the leading nations of the world, the defense demand values are 61 percent for the U.S., 62 percent for West Germany, 77 percent for France and 67 percent for Great Britain, and it is clear that the defense demand with its high percentage supports the foundation of the aircraft industry of these nations. This is especially true in Japan with its heavy dependence on defense demand. Defense demand is determined by national defense policies or national finances, and it is not directly related to such factors as the business operations of the suppliers or

Figure 6. Breakdown by Demand

Key: (1) Percentage
(2) U.S. military's special procurement
(3) Defense Agency's demands
(4) Civil demands
(5) Exports
(6) Showa year designation
(7) 27 = 1952
(8) 53 = 1978



business trends of industries in general. Actually defense demand declined during the years 1965 to 1967, but this occurred because of the decrease in the amount of work during the transitional periods of the Second Defense Build-up Plan (FY 1962 to 1966) and the Third Defense Build-up Plan (FY 1967 to 1971). Because dependence on defense demand is evident more during transition, Japan's aircraft industry is saddled with the basic problem of the defense budget which, unrelated to economics, influences production.

At present, the National Defense Council has decided to procure 100 F-15s as the next generation mainstay fighters by FY 1986 and 45 P-3Cs as the next generation antisubmarine patrol aircraft by 1988, as defense demand. These totals include 82 and 42 aircraft, respectively, programmed to be knockdown, domestically produced. With the FY 1978 to 1980 budgets, 57 and 18 aircraft, respectively, including those imported, have already been secured. Furthermore, the plan to develop the small-size XF-3 turbo-fan engine for mounting on the MTX next generation medium trainer is progressing smoothly and its development is expected to be completed by FY 1985. In this manner it is felt that the aircraft industry as it relates to the defense demands will be actively engaged for some time to come.

If hereafter the aircraft defense budget is going to, like the total defense budget, be increased similar to the rate of GNP growth, then from the standpoint of seeking to expand the scope of Japan's aircraft industry, and from the standpoint of making the dependence on the defense demand, which is big in transition, as a reasonable value, the growth of the civil aircraft industry is all the more a necessity.

3. Development Projects on Japan's Principal Civil Aircraft and Jet Engine for Civil Aircraft

(1) Next Generation Civil Transport (YX) Development Plan

Japan's first, post-war developed aircraft, the 60-passenger, twin-engine turboprop YS-11 transport, received its model certification in 1964 and after its development was completed, the study on the development of the next generation civil transport was begun from around 1967.

At the outset, the plan called for independent development as with the YS-11, but upon receiving a proposal for joint development from the Boeing Co., it took a turn in the direction of the international joint development. In September 1978, the

Civil Transport Development Association, Japan's principal developer, and the Boeing Co. signed the final business contract to develop a civil transport, and in October 1979 manufacture of the experimental model was begun. (Figures 7 and 8)

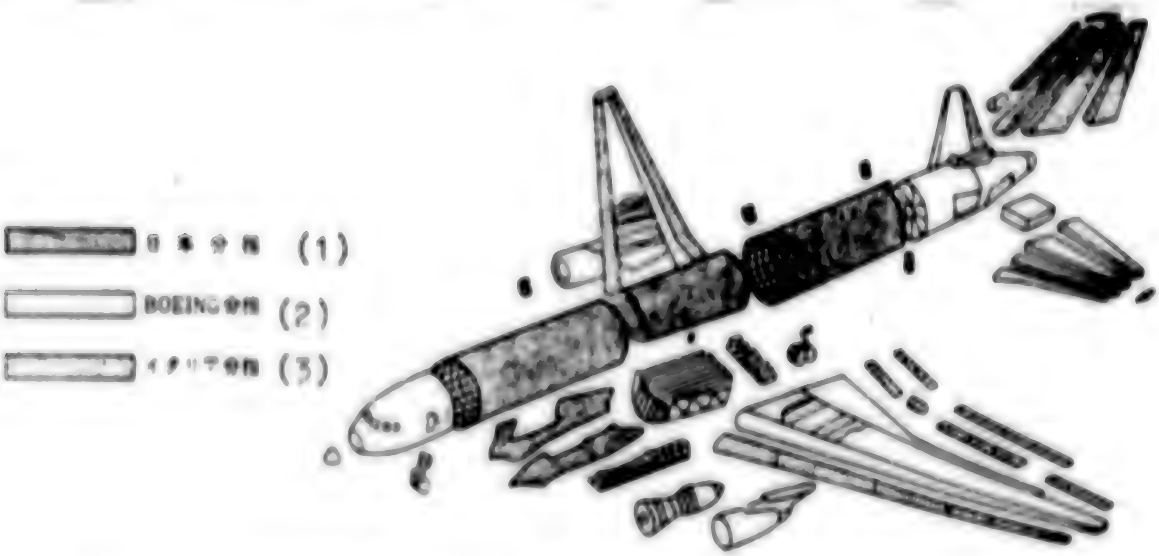


Figure 7. Aircraft Manufacturing Assignments

Key: (1) Japan's assignment
(2) Boeing Co's assignment
(3) Italy's assignment

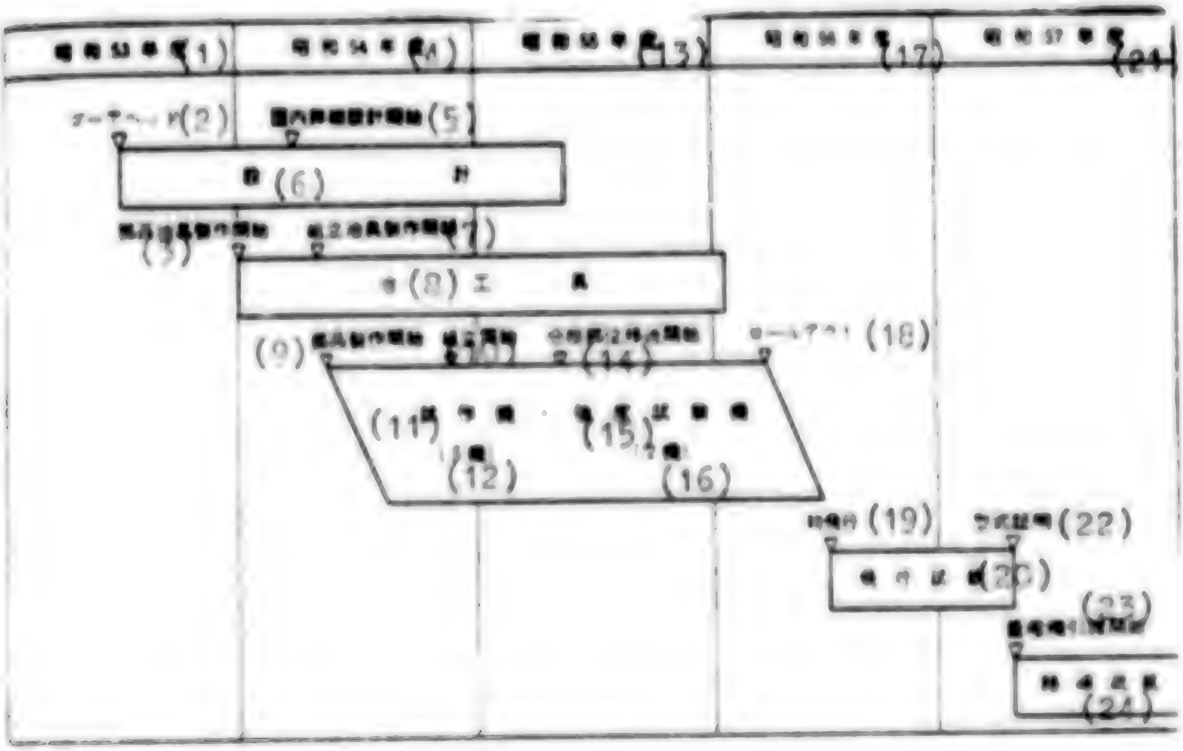


Figure 8. YX Development Schedule (767)

[Key on following page]

[Key to Figure 8]

(1) FY 1978
(2) "Go ahead"
(3) Begin manufacturing metal components
(4) FY 1979
(5) Begin detailed design in Japan
(6) Design
(7) Begin manufacturing assembly metal tools
(8) Metal tools
(9) Begin manufacturing components
(10) Begin assembling
(11) Trial manufactured aircraft
(12) Five aircraft
(13) FY 1980
(14) Begin transferring assigned section
(15) Power test aircraft
(16) Two aircraft
(17) FY 1981
(18) Roll out
(19) First flight
(20) Flight test
(21) FY 1982
(22) Model certification
(23) Begin delivering mass produced aircraft
(24) Placed enroute

The world's passenger transportation demands have achieved an average annual growth of 11.5 percent during the past 18 years. It is reported that hereafter with the slowdown in economic growth, along with the slowdown in the increase of the demands, there will be a steady growth at an average annual growth of about 7.2 percent. With reference to the transport that would meet the demands, throughout the world there were 6,458 aircraft in 1978, but forecasted are about 7,000 aircraft in 1985 and about 10,000 aircraft in 1995. Along with the tightening of noise control and the absolescence of existing aircraft, it is reported that a large switchover in demands will occur by the middle of the 1980's.

The YX plan calls for the development of the B-767 and B-777, the new type jet passenger aircraft, programmed for the market in the 1980's. The YX will adopt an advanced wing type; will have the airframe weight reduced through use of composite materials; will utilize the most recent technology such as in reduced noise nacelles and high accuracy, high reliability control systems; and the salient selling points of the plan will be low fuel costs, reduced noise and comfortable passenger cabins. The B-767 will have a seating capacity of from 200 to 300 seats, flight range of about 5,000 km and a capability to take off and land at a 1,800 m class airport.

Japan will assume about 15 percent of the airframe development operations, mainly the fuselage, the wing-fuselage faring and a part of the main wing. Based on the subcontracting agreements with the Civil Transport Development Association, the Mitsubishi Heavy Industries, Ltd., Kawasaki Heavy Industries, Ltd. and Fuji Heavy Industries, Ltd. have engaged in development manufacturing of their allotted assignments. In turn the Mitsubishi Heavy Industries, Ltd. and Kawasaki Heavy Industries, Ltd. subcontracted the Shin Meiwa Industry Co., Ltd. and the Japan Aircraft Co., Ltd. to engage in development manufacturing.

Japan has just about completed the detailed plans for the assignments allotted her thus far and presently metal tools and components are being manufactured. Japan is scheduled to begin transferring her assigned items to Boeing Co. from this summer. Thereafter, Boeing Co. is programmed to undertake the final assembly operations, begin flight tests from July 1981, acquire its model certification in August 1982 and begin delivering the aircraft to the various airlines.

The B-767 has a tremendous headstart for already 12 firms have placed orders for 284 of this aircraft (134 of them on option) and this total includes the 40 aircraft ordered by the All Nippon Airways Co., Ltd.

Also Japan's component makers have received orders for apparatus, components, etc. directly from Boeing Co. Already 10 firms have received orders exceeding the sum of 15 billion yen.

In this manner, the XY plan is a project that has upgraded the overall capability of Japan's aircraft industry and the government is programmed to give positive support by granting a subsidy (one-half of the financial assistance) amounting to 16.8 billion yen during the 5-year period from FY 1979 for the development operations of the Civil Transport Development Association.

(2) Japanese-British Joint Development Plan (XJB Plan) on an Aircraft Jet Engine

The XJB Plan is based on the technological knowledge accumulated from such projects as the FJR Project which is the aircraft jet engine development plan that was pursued as a large-scale project system by the Agency of Industrial Science and Technology of MITI. The joint development agreement between Japan's three jet engine manufacturers (Ishikawajima-Harima Heavy Industries Co., Ltd., Kawasaki Heavy Industries, Ltd. and Mitsubishi Heavy Industries, Ltd.) and the British Rolls Royce Co. on the XJB Plan to develop a jet engine (engine model RJ 500) for civil aircraft with a trust of about 9 tons was signed in December 1980 (sic).

The XJB will be a fanjet engine with a by-pass ratio of 4.8 to achieve reduced noise, low fuel cost and reduced pollution, and is programmed to be mounted to a 130-passenger class twin engine transport. The period of development is 8 years, from FY 1980 to 1987. (Figure 9) The total cost of the development is estimated to be about 140 billion yen to be shared on a 50-50 basis by Japan and Great Britain. As to the development assignments, (a) the basic design will be worked on jointly, (b) on specific designs and engine tests, Japan will oversee the fan, low pressure turbine, etc. and Great Britain will be charged with the compressor, combustor, high pressure turbine, etc. and (c) the complete assembly and final tests will be performed jointly.

A joint company with equal capitalization between the Japanese and British was established on 3 April 1980 to implement the coordination of developing and manufacturing the XJB. The sales of the engines, project support, etc.

4. Outlook of Japan's Aircraft Industry

(1) Civil Aircraft Development Plans After the YX

The Industrial Structure Council, in its report "What our international trade and industry policies during the 1980's should be," published in March 1980, proposed the active promotion of development plans to follow the YX and XJB Plans; and the policy committee of the Aircraft Industry Council stated, "On the development of a 100-seat class or a slightly larger type aircraft, as regards the development of a civil transport after the YX, studies will be continuously made on problems of the partner in an international joint development arrangement and on the relationships after the YX-11 (sic), for a positive development plan." These are extracts from interim reports.

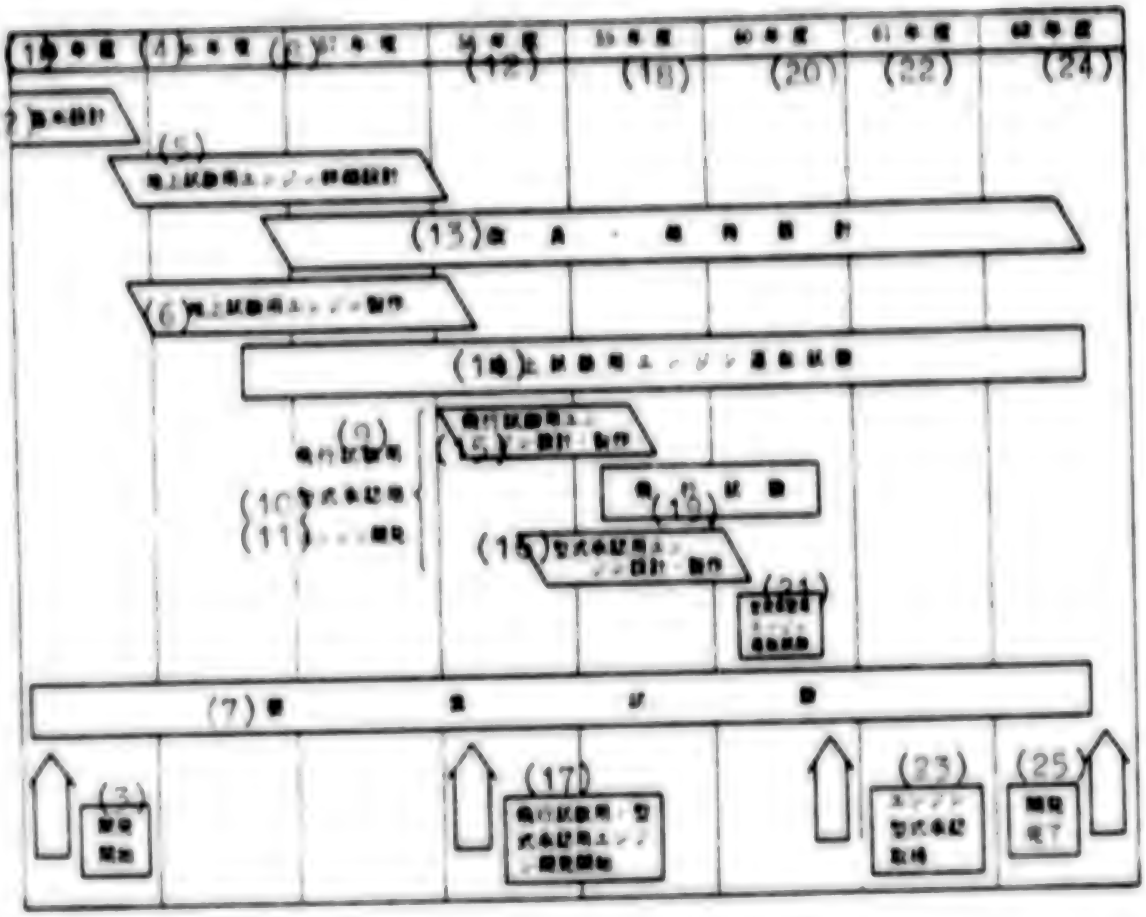


Figure 9. XJB Development Schedule

Key:
(1) FY 1980
(2) Basic design
(3) Begin development
(4) FY 1981
(5) Detailed design of ground test engine
(6) Manufacture ground test engine
(7) Element test
(8) FY 1982
(9) For flight test
(10) For model approval
(11) Engine development
(12) FY 1983
(13) Improvement/maintenance design
(14) Operational test of ground test engine
(15) Design and manufacture of flight test engine
(16) Design and manufacture of model and certified engine
(17) Begin development of flight test/model certified engine
(18) FY 1984
(19) Flight test
(20) FY 1985
(21) Operational test of model certified engine
(22) FY 1986
(23) Acquire engine model certification
(24) FY 1987
(25) Development completed

The following are summaries of joint development proposals submitted by foreign countries, as of the present:

(1) Proposal by Fokker Co.

The Dutch aircraft manufacturer, the Fokker Co., has under study a plan to newly develop a twin-engine jet aircraft with a passenger capacity of about 130 seats and a flight range of about 2,800 km. It has made overtures to have Japan manufacture the main wing.

(2) Proposal by Airbus Industrie Co.

The Airbus Industrie Co. is a joint enterprise, consisting of France, West Germany, Great Britain and Spain, and it has plans of newly developing the SA-1 (Single Aisle) twin-engine jet aircraft with a passenger capacity of about 110 to 130 seats and the SA-2 with 160 seats. A study period of about 2 years is considered a necessity. One proposal is to have Japan join the partnership and assume about one-fourth of the assignments.

(3) Proposal by Dassault Breguet Co.

Dassault Breguet Co., a French aircraft manufacturer, has continued studies on its twin-engine jet aircraft, Mercourou, with a passenger capacity of 120 to 150 seats. It has sent overtures to Japan to participate and undertake the improvement of a part of the aircraft.

(2) Direction of Japan's Aircraft Industry Policies Hereafter (Conclusion)

The progress achieved by Japan's aircraft industry is attributable (1) to the untiring efforts exerted by the aircraft manufacturers themselves in bringing about this situation and (2) like in the highly advanced nations, to the support rendered by the government with its policies which became of tremendous help. The policies of Japan's aircraft industry hereafter, while following a part of the policies instituted thus far, must expand with the following three principles as bases:

First is adherence to an unrestricted aircraft trade policy. For this, as pertains to civil aircraft and its components, (1) eliminate import duties, (2) eliminate limitations on import quantities and (3) watch that government assistance will not exert a bad influence on aircraft trade. These are provisions of the Multilateral Trade Negotiations Civil Aircraft Pact reached in agreement last year by the United States, EC, Sweden and Japan. Recently, on the issue of Japan's automobile exports to the United States, Mr Fraser, president of the United Auto Workers, at the public hearing at the joint economic committee of both houses of Congress, made the statement that "On importing aircraft, our country places an obligation on local contents," but with Defense Agency aircraft, to some extent domestic manufactured ones are guaranteed from the standpoint of maintaining the country's security, but on importing civil aircraft, there has never been any instance of placing obligation on what he referred to as local contents. In this manner, Japan today and hereafter will be a strong advocate of free trade on civil aircraft, and Japan's aircraft industry will not only rely on the domestic market, but it will seek world markets and strive for aircraft development that will be highly competitive businesswise.

The second principle is, on Japan's aircraft development in the future when the size of the aircraft project is greater than a predetermined level, to enter into an international joint development arrangement. Aircraft development essentially is inherent with large risks in the market on capitalization and technology. Spreading this risk by international joint development is the general practice among the principal nations in their aircraft development policies. Such aircraft as the Concorde, the A-300 and A-310 of the Airbus Industrie Co. are based on international joint development and even in Japan the YX and XJB are engaged by international joint development. Civil aircraft development after the YX will probably follow suit.

The third principle is that the final risk in aircraft development should not be borne by the government but by the private industries. In Europe, aircraft or engine development is undertaken by state operated companies such as the British Aerospace Co. and Rolls Royce Co. of Great Britain, Aerospecial Co. and SNECMA Co. of France, Aeritalia Co. of Italy. In the case of the YS-11 in Japan, the semi-governmental Japan Aircraft Manufacturing Co. engaged in development and production, and the government assumed a part of the final risk. However, after the YX, the government has taken the following stances: (1) in order to have the maximum involvement of the full strength of a civilian enterprise in aircraft development, a state operated company will not be a participant, (2) even if financial assistance is rendered by the government in the development stage, such funds will be returned to the government should the project be successful and (3) special assistance will not be rendered at all during production, and in sales Japan will probably maintain these policies in the future.

It is felt that with the active promotion of the aircraft industry policies based on the above three principles, along with greater efforts expended by private industries, Japan's aircraft industry attaining first rate level of the world is in the not too distant future.

Space Industry

Tokyo KOGYO GIJUTSU in Japanese Vol 21, No 6, Jun 80 pp 28-31

[Article by the Space Industries Office, General Affairs Section, Machinery and Information Industries Bureau, MITI]

[Text] 1. The Progress of Space Development and Its Practical Application

Since the launching of mankind's first artificial satellite, Sputnik 1, by the Soviets in 1957 and up until today, more than 2,000 artificial satellites have been launched by 15 countries and two international agencies.

During the period, the diversified uses and functions of the artificial satellites have been remarkable and from these various areas, within 10 years from the successful launching of Sputnik 1, satellites for practical use were developed for truly inspiring advancements. (Table 1) In the area of the earth observation satellite, since the launching of Landsat-1 in 1972, its usefulness has been widely acknowledged, and President Carter in November 1979 approved the jurisdictional transfer of the Practical Earth Observation Satellite Plan from NASA to the Department of Commerce for its continued activity.

Table 1. The World's First Satellites for Practical Application

Purpose	Year launched	Name of Satellites	Launched Rocket	Remarks
Stationary inter-station communications	1965	INTELSAT-1	Thor Delta	Communications between Europe and America
Ocean communications	1975	Navsat	Thor Delta	
Navigation support	1963	Navsat	Scout	Military use
Meteorological observation	1966	ESSA-1	Thor Delta	
Geodetic satellite	1964	Anna-1	Thor A Blue Star	Military use

As described above, the United States and the USSR are the principal contributors to the advancement of space development. And now, to describe the situation in Japan.

Japan's space development began in 1955 with a budget of slightly under 20 million yen when the University of Tokyo undertook research and development of solid propellant rocketry to develop a space observation rocket. In 1970, the "Osumi" was launched by the University of Tokyo, making Japan the fourth nation in the world to launch a satellite. Since then and up to the present, 11 satellites for scientific research and nine satellites for practical application, or a total of 20 satellites, have been launched, thereby giving Japan recognition as a member of the space-advanced nations (Table 2).

Even the size of the budget shows growth in that for FY 1980 the total almost reached the whopping 100 billion yen mark for the first time. A comparison of the various countries and budgets up until 1978 shows that Japan ranks second largest next to the United States amongst the Western nations. (Figure 1)

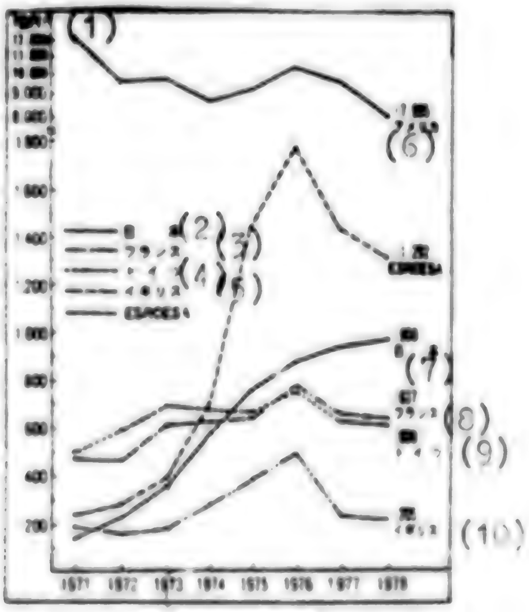


Figure 1. Budget on Space Development by Countries

Key:
(1) Unit value = 100 million yen
(2) Japan
(3) France
(4) Germany
(5) Great Britain
(6) United States
(7) Japan
(8) France
(9) Germany
(10) Great Britain

Table 2. Performances of Japan's Past Artificial Satellites Launched and Plans

Shows Year Designation	University of Tokyo		National Space Development Agency of Japan (NASDA)		
	M Rocket	Others (Using U.S. Space Shuttle)	N-1 Rocket (about 130 kg on stationary path)	N-2 Rocket (about 350 kg on stationary path	U.S. Rocket (Delta 2914 (About 350 kg on stationary path)
44	← "Osumi"				
45	Experimental satellite ← "Tansei"				
46	Scientific Satellite 1 (MS-F2) ← "Shinsei"				
47	Scientific Satellite 2 ← (REXS) "Denpa"				
48	Experimental Satellite ← "Tansei-2"				
49	Scientific Satellite 3 ← (SRATS) "Taiyo"				
50			Engineering test ← satellite I (ETS-I) "Kiku" Ionosphere sounding ← satellite (ISS) "Ume"		
51	Experimental ← Satellite "Tansei-3"		Engineering test ← satellite II (ETS-II) "Kiku-2"		
52	Scientific Satellite 5 ← (EXOS-A) "Kyokko"		Ionosphere sounding satellite ← (ISS-b) "Ume-2"		Geostationary meteorological satellite ← (GMS) "Himawari" Medium capacity communications satellite for experimental ← purpose (CS) "Sakura" Medium scale broadcasting satellite for experimental purpose ← (BS) "Yuri"

[Table 2 continued]

Shows Year Designation	University of Tokyo		National Space Development Agency of Japan (NASDA)		
	M Rocket	Others (Using U.S. Space Shuttle)	N-1 Rocket (about 130 kg on stationary path	N-2 Rocket (about 350 kg on stationary path)	U.S. Rocket (Delta 2914 (about 350kg on stationary path
53	← Scientific satellite 6 (EXOS-B) "Jikiken" ← Scientific satellite 4 (CORSA-b)		← Experimental communications satellite (ECS-a)* "Ayame"		
54	← Experimental satellite "Tansei-4"		← Experimental communications satellite (ECS-b)* "Ayame-2"		
55	⇦ Scientific satellite 7 (ASTRO-A)			⇦ Engineering test satellite IV (ETS-VI) (sic)	
56			⇦ Engineering test satellite III (ETS-III)	⇦ Geostationary meteorological satellite 2 (GMS-2)	
57	⇦ Scientific satellite 8 (ASTO-B)	⇦ Space experiment with particle accelerators (SEPAC)		⇦ Communications satellite 2a (CS-2a)	
58	⇦ Scientific satellite 9 (EXOS-C)			⇦ Communications satellite 2b (CS-2b) ⇦ Broadcasting satellite 2a (BS-2a) ⬅ Geodetic satellite (GS-1)	
59	⬅ Scientific satellite 10 (PLANET-A)			⇦ Marine observation satellite 1 (MOS-1)	
60					⇦ Broadcasting satellite 2b (BS-2b)

← Artificial satellite launching completed
⇦ Launching of artificial satellite planned (in development stage)
⬅ Artificial satellite whose launching is requested (in research development stage)
* Artificial satellite whose launching was a failure

Table 3. Japan's First Satellites for Practical Application

Purpose	Year Launched	Name of Satellites	Launched Rocket	Remarks
Stationary inter-station communications	(1982)	Communications Satellite 2a	N-II	Domestic communication
Broadcasting	(1983)	Broadcasting Satellite 2a	N-II	Domestic Broadcasting
Meteorological observation	1977	Geostationary Meteorological Satellite "Himawari"	Delta	GARP Plan participation

It can be substantially called Japan's first practical satellite.

Plans are also underway to launch practical satellites for communications and broadcasting purposes and Japan can be said to be on the threshold of entering the era of practical application.

2. Concepts of the Space Industry

Any industry that supports space development activities such as launching an artificial satellite is called a space industry. However, the ramifications of the space industry are so wide in scope that defining them would be a task. This is all the more so because of the difficulty in forecasting the possible emergence of new industries with the era of space development for practical applications already ushered in. A bold definition would be "an industry that furnishes equipment and services for space development and use," and this would include in addition to the manufacturing of rockets and artificial satellites, the ground facilities, the manufacturing of data receiving, processing and analysis apparatus as well as the development and transportation of software, etc., as relates to the above.

The Japan Machinery Industry Federation conducted a "Fact Finding Survey on the Space Industry" in October 1979. The survey was conducted with private enterprises that were assumed to be related to the space industry and replies were received from 65 companies. A breakdown by industries revealed the iron and steel industry, chemical industry, electrical machinery and equipment manufacturing industry, machinery and equipment manufacturing industries in general, export machinery and equipment manufacturing industry, precision machinery and equipment manufacturing industry, rubber products manufacturing industry, wholesale industry, information service industry, installation and construction industry, but on the basis of the substance of the industries mentioned above, such industries as the non-ferrous metal manufacturing industry (materials such as aluminum and titanium), metal products manufacturing industry (heat treatment) would be included.

3. Present State of the Space Industry

The above fact finding survey on the space industry is the first of its kind, but because of the conditions described by the responding private businesses, portions of the survey are inaccurate. This survey is of tremendous significance from the standpoint of furnishing a general picture of the space industry for the first time. It will be used as a basis in describing the present state of Japan's space industry.

(1) Structural Private Business

Private business engaged primarily in space activity, like the Mitsubishi Space Software and the Nippon Propellant Industry, are few. And even if a company establishes a space section and engages in it wholeheartedly, from the standpoint of its share in the total sales, its contribution is not great. Thus, the percentage of the total sales of a space section versus that of a space specialty company is a mere 0.4 percent and in terms of working personnel about 1 percent. In other words the contribution of space activity is very small (FY 1978).

From the standpoint of business organizations, the three giants in space activity are Mitsubishi Heavy Industries, Ltd., Nissan Motor Co., Ltd. and Ishikawajima-Harima Heavy Industries, Ltd. As for satellite and ground facilities, the all around electrical manufacturers, such as Nippon Electrical Co., Ltd., Mitsubishi Electric Corporation, Toshiba Corporation and Fujitsu, Ltd., have been assuming big roles. Actively engaged in business with these firms are the many private enterprises such as trading firms, electrical component makers (Murata Manufacturing Co., Ltd.) and software (Nippon Electronics Development and Nippon S. D. C.)

(2) Sales

Sales of the space industry from FY 1975 to 1978 are shown on Table 4. Sales totalled 105.4 billion yen during FY 1978 while the 4-year total was 379.7 billion yen or an average growth rate of 6.5 percent. The breakdown is: launched body including rocket, satellite, etc., about 52 percent; ground facilities, about 41 percent and software, about 8 percent, so that the flight and ground portions are about the same.

Since the bulk of Japan's space requirements is assumed by the government's space activity, the total of 355.9 billion yen is just about the same as the space budget during the given periods.

(3) Exports and Imports

Exports of the space industry have been increasing by the year and the total amount from FY 1975 to 1978 was 57.3 billion yen. Because of export restrictions on the launched body, the amount was a mere 1.9 billion yen which was for the transponders and other items made principally by Nippon Electrical Co., Ltd. and Mitsubishi Electric Corporation. The special components used have been considered to be of world standards and much is expected hereafter. Semiconductors and other electronic components are reportedly used to some extent for space projects in the United States and Europe, but the scope and details are unknown. The amount of 55.3 billion yen for ground facilities constitutes 97 percent of the total exports. These were principally for the Intelsat ground stations and it is reported that Japan's manufacturers furnish one-third to one-half of the needs of the world's ground stations. That this is Japan's forte is only natural because Japan's electronic and communications technologies are of world standards. The amount for software is only 100 million yen, considerably lower than the others, but its growth is anticipated hereafter.

Table 4. Total Sales from 1975-1978

Showa year designation Principal items	Performance; unit value is 100 million yen				Total for 1975-1978 inclusive	
	1975	1976	1977	1978		Breakdown percentages
Rockets	184	203	173	191	751	19.8
Artificial satellites	288	263	221	304	1,706	28.3
Components of rockets and artificial satellites	28	26	33	36	123	3.2
Equipment for space in-flight use (includes equipment for space shuttle mounting)	0	0	2	7	9	0.2
Launched bodies	500	492	429	538	1,959	51.6
Ground stations	245	327	202	364	1,138	30.0
Data receiving, processing and analysis apparatus	94	120	93	106	413	10.9
Ground facilities	339	447	295	470	1,551	40.8
Software development	26	69	95	33	223	5.9
Data processing and analysis	9	14	28	13	64	1.7
Software	35	83	123	46	287	7.6
Total	874	1,022	847	1,054	3,797	100.0

Remarks: Subsystems for communications, heat control, second stage propulsion, etc. are included in the rocket, equipment for space in-flight use and the artificial satellite. The same for the items below.
Components of rockets and artificial satellites refer to machine components, electrical components, heat processed components, etc. The same for the items below.

Although a descending trend in imports is noted, the total amount of imports from FY 1975 to 1978 was 107.5 billion yen, indicating an unfavorable trade balance of 50.2 billion yen. The breakdown is: launched bodies, 73 percent, ground facilities, 18 percent and software, 9 percent. Only the subject of ground facilities showed a favorable trade balance to the amount of 36.3 billion yen.

(4) Investments on Facilities, Etc.

Excluding the facilities and other items included in the orders of the National Space Development Agency of Japan (NASDA), private business invested a total of 13.2 billion yen of their capital in facilities from FY 1975 to 1978 and spent a total of 13.7 billion yen for research and development. The ratio of research and development expenses to total sales is 3.6 percent which is almost the same (3.7 percent) for communications, electronic and measuring equipment.

4. Future Outlook on the Space Industry

In comparison with the expendable type rockets used heretofore for space travelling, the United States has developed the extremely economic space shuttle whose maiden flight is programmed during 1980-1981. Because the transportation of a 1 kg payload into space can be realized at the low rate of a mere $1,000 through this method, interest in the practical use of space has accelerated not only in the government, but also among private interests, and a rapid expansion of the market is anticipated.

NASA's outlook up until the 21st century is as follows: Develop such prospective technologies as space construction and convert existing type satellites to larger scale with higher performances, from 1980 to 1987; employ an improved space shuttle to realize a transportation cost of $250 per kg payload, construct a large-scale station to serve as a base to assembly structural materials at low orbit, thereby entering the era of practical application with low orbit space utilization, from 1988 to 1995; and then employ a heavy lift launch vehicle (HLLV) to realize a transportation cost of $30 per kg, launch into geostationary orbit a solar power satellite (SPS) that would generate several million KW of electric power for use on earth and to engage in full scale construction of a space structure that would operate as a space plant, from 1996 to 2005. NASA has been making steady progress with these projects.

In Europe, the Arianne rocket is being developed to compete against the space shuttle and the recent establishment of a company to manage it with France taking the lead and other activities indicate their tremendous participation to gain a share of the practical utilization of space.

In light of these world trends, Japan has plans to launch numerous satellites, has pushed on to develop application satellites such as the Geostationary Meteorological Satellite 2 and Communications Satellite 2 for certain substantial functions, and to develop such satellites as the Marine Observation Satellite 1 that would be the first step in developing earth observation satellites for future practical application (see Table 2). MITI, besides planning for the positive development of a resources and energy policy, plans to promote an active space industry by conducting investigative research with resource exploration satellites in order to upgrade space technology.

Thus, hereafter, by coping smoothly with the enlarging market of the lively space activities at home and abroad, Japan can expect a tremendous growth of her space industry and the prospects are boundless.

Atomic Energy Apparatus Industry

Tokyo KOGYO GIJUTSU in Japanese Vol 21, No 6, Jun 80 pp 32-35

[Article by the Electronic Apparatus and Electric Machinery Section, Machinery and Information Industries Bureau, MITI]

[Text] 1. History of Its Development

The history of Japan's atomic energy development begins with the appropriation of an atomic energy budget in 1954 following President Eisenhower's "Atoms for Peace" proclamation in 1953. The world's atomic energy development was limited to the generation of electricity from atomic energy, the world's first by the United States in 1951, and Great Britain constructing the Calder Hall type nuclear power station in 1954. The First International Conference on the Peaceful Uses of Atomic Energy (Geneva Convention) in 1955 caused the world's established by 1956.

(1) 1956: The Atomic Energy Commission (AEC) was established. The Japan Atomic Energy Research Institute (JAERI) was established as a foundation in 1955 and then changed to a special corporation in 1956. The Japan Atomic Fuel Corporation was established and changed to the Power Reactor and Nuclear Fuel Development Corporation in 1967.

(2) 1956: The Japan Atomic Industrial Forum (JAIF) was established; the Mitsubishi Atomic Power Industries, Inc. (MAPI), consisting of Mitsubishi corporations, was established in 1955; the Tokyo Atomic Industrial Consortium (TAIC), consisting of Hitachi, Ltd. and other companies; the Sumitomo Atomic Energy Industries, Ltc. (SAEI), consisting of Sumitomo corporations; Nippon Atomic Industry Group, Ltd. (NAIG), consisting of Mitsui corporations and the First Atomic Power Industry Group (FAPIG), consisting of Fuji Electric Co., Ltd. and other companies, were successively established. Today the Atomic Energy Group is comprised of these consortiums.

The most complete nuclear reactor then was the GCR type reactor of Great Britain which had been the first nation in the world to consider developing nuclear power generation as an energy source, after the Suez crisis. Japan sent a survey mission to Great Britain in 1956 to study the GCR reactor and this survey became the basis to plan for the early realization of nuclear power generation. After the famous Shoriki-Kono debates, the Japan Atomic Power Company (JAPC) was formed to import the GCR reactor.

In the midst of negotiations to import the GCR reactor, the United States began making overtures for importing a light water reactor and it was decided to bring in the JPDR power demonstration reactor to JAERI in 1959. Prior to this, nuclear research at JAERI was progressing smoothly for in 1956, the JRR-1 (water boiler type) and subsequently the JRR-2 (CP-5 type) were imported from the United States; at the same time, the conceptual design of the first domestically manufactured reactor (JRR-3: natural uranium heavy water type) was completed in 1956 and its criticality was decided in 1962. Japan decided to import the GCR type from Great Britain as its first commercial-use power reactor, but the FAPIG with Fuji Electric Co., Ltd. as leader subcontracted with the British GEC to participate in its construction. This reactor began operating in 1966, but the percentage of domestic manufacture of this reactor was about 35 percent and the bulk of the main apparatus was imports.

But just as the Nuclear Industries Section mentioned in its report in 1960 that "the prospect of nuclear power generation competing against fuel oil thermal generation will occur around 1971," nuclear power generation encountered a slowdown period because of such reasons as the drop in petroleum prices with successive discoveries of petroleum resources and the drop in thermal power costs with technological progress.

According to the survey by JAIF, nuclear power sales reached the sum of 13 billion yen in 1963 after which sales decreased for 3 years, and the research expenditures of the nuclear power supply industry constituted about 40 percent of the total expenditures. Generally during the period from 1956 to 1965, Japan's nuclear power development had just started, widely outdistanced by the industrially advanced nations of Europe and the United States, and the stage was set to prepare for practical utilization by having industries accumulate technological knowledge.

In 1966, the AEC decided on a policy "to develop the fast breeder reactor and new type converter as national projects, and to step up independent development in an all out effort with government and private resources to the allowable limit," and the Power Reactor and Nuclear Fuel Development Corporation was established in 1967. At the same time, by reconsidering the economic factor of the light water reactor (600,000 KW/BWR) which was based on the American Oyster Creek reactor, Japan heightened its interest on nuclear power generation.

The JAPC commenced constructing the Atsuga power plant (BWR: 35; 70,000 KW) in 1966 and successively began constructing nuclear power stations such as the Tokyo Electric Co's Fukushima power plant, Kansai Electric Co.'s Mihama power plant and the Chugoku Electric Co's Shimane power plant.

This nuclear power boom can be discered for the nuclear power outlay by the electric companies during the slowdown period was around 5 billion yen whereas the outlay for FY 1969 was ten times greater, having reached 59 billion yen. Then the long range plan of the nuclear power development and use of the AEC underwent an increased revision when the 30 million to 40 million KW [output] programmed for 1985 in the 1967 policy was increased to 60 million KW programmed for 1985 in the 1972 policy revision.

The nuclear power development at the outset was programmed for imports, as described in the 1964 report of the Nuclear Industries Section below.

In order to develop nuclear power generation efficiently, in the initial stage, along with importing reactor types already in practical use abroad, electric company personnel must exploit their individual experiences to mutually cooperate and develop comprehensive plans. In case equipment and materials are required, then related manufacturers must be established and as much as possible the conversion to domestic manufacturing must be expedited.

Japan's nuclear reactor manufacturers signed technical tie-up contracts with American light water reactor manufacturers during the early years of the 1940's and began as subcontractors to General Electric and Westinghouse in making the first reactor; thereafter, the Japanese manufacturers became the principal contractors and gradually strengthened their system for domestic manufacture.

Fuel manufacturing began with GE, Hitachi and Toshiba forming the JNF, then the Sumitomo Nuclear Fuel Co., Ltd. and Mitsubishi Nuclear Fuel Co., Ltd. were established in the mid 1940's, laying the groundwork for the present situation.

The nuclear power industry grew steadily with these activities and nuclear power sales surpassed the huge 100 billion yen mark for the first time, in FY 1972, to reach the sum of 117.8 billion yen. (The financial outlay for the same year was 125.9 billion yen.)

On the other hand, the economic growth rate had dropped along with the lag in power requirements after the oil shock, and so under these conditions, high hopes had been placed on the fully economical nuclear power generation to replace the expensive petroleum thermal installations, but at the same time the problem of locations for nuclear generation arose.

Then in 1974, three laws on power source were enacted to facilitate the construction of power plants. These were the law on environmental zoning of power installations, tax law to promote power source development and a special audit law to promote power source development.

The report of the Supply-Demand Section of the Advisory Committee for Energy in 1975 revised the nuclear power generation goal for 1985 to be 49 million KW; in 1978, the AEC in its revised long range plan made a decreased revision of from 27 to 33 million KW; then in December 1979, the report of the Electric Supply Section of the Electric Industry Council further revised it to be 28 to 30 million KW and presently efforts are directed to reach this goal. The above reports forecasted the power source output at the end of FY 1990 to be 51 to 53 million KW and that for the end of FY 1995 to be 74 to 78 million KW.

2. Present State and Future of the Nuclear Power Apparatus Industry

The nuclear power apparatus industry accounted for sales totalling 580 billion yen in FY 1978 and among other things has progressed in research and development of nuclear power to expand steadily. However, the expenditures alone may give the impression of a brightening future, but actually the prospect for settlement of the accumulated deficits is dim. The locational problem has caused purchases to be unstable and business finances have remained unstable.

Exports constitute only a small percentage of the total sales, but growth in the future to develop into an export industry is anticipated; however, because of such factors as the slackened tempo for constructing nuclear power plants abroad at the present time, rapid progress cannot be anticipated.

Technologically the conversion to domestic manufacture of apparatus has reached advanced levels, the efforts for revision and standardization undertaken since FY 1975 have yielded results and considerable technological know-how has been attained.

Revision and Standardization

Because of the frequent occurrences of trouble with the imported light water reactor and the move to standardize plants which are to be installed abroad, the revision and standardization program was begun with government and private industry cooperating on a 6-year plan from FY 1975 to upgrade the availability factor (the first phase revised and standardized plant had a time availability factor of about 75 percent and the second phase of about 80 percent), improve reliability and minimize exposure. (Table 1)

Table 1. Objectives of a Standard Plant

	Plants in the past	First phase standard plant	Second phase standard plant	Measures Taken
Number of days for scheduled inspection	90-100 days (no repairwork needed)	About 85 days	About 70 days	Acceleration of fuel exchange, etc.
Operating time percentage	Wide differences depending on plant	About 75 percent	About 80 percent	SCC-proof measure
Exposure of workers	(using 100 as whole)	65-75	30-50	Install automated ISI equipment

Remarks: To determine operating time percentage, if scheduled inspection lasted 90 days and the plant was in operation the rest of the year, then 365-90/365+75 percent. Generally nuclear power plants are closed during the summer inspection, etc.

(1) First phase revision and standardization (FY 1975-1977)

Minimize exposure to the employees and upgrade operating efficiency by enlarging the container, etc.

(2) Second phase revision and standardization (FY 1978-1980)

Revise the apparatus, system, etc. and broaden the scope of standardization with the first phase revision and standardization as basis.

First phase revised standard reactors currently under construction are the PWR as the first one at Kawauchi and the BWR as the second one at Fukushima #2. It must not be forgotten that in nuclear power development, from the time the safety inspection is completed, to plant construction and until its operation would require a long period of 5 or 6 years, and subsequently certification of its technological assessment would be made way later.

From the standpoint of easing the location problem, reliability demonstration tests of the principal apparatus of a nuclear power plant were made from FY 1975, and besides the six tests, enumerated below, recommended by MITI offices, such agencies as the Science and Technology Agency are recommending such tests as the "Container spray effect demonstration test" and the "Large type submersion effect demonstration test."

(1) Steam generation reliability demonstration test.

(2) Valve reliability demonstration test.

(3) Fuel assembly reliability demonstration test.

(4) Welded and heated areas reliability demonstration test.

(5) Pump reliability demonstration test.

(6) Nuclear power generation facility earthquake-proofing reliability demonstration test.

As pertains to the light water reactor technology, using the Three Mile Island nuclear power plant accident of March last year as an example, it can be said that a turning point is about to be reached because more complete safety measures are being considered, the importance of quality guaranteed systems pertaining to design, manufacture and operation of nuclear power plants is recognized, studies on "how it should be" are zealously conducted, the importance of operational management and facilities management is stressed, the development of nuclear power generation support systems is in the process, etc.

Today when the development and introduction of an oil-replacing energy is an urgent matter, the hope on nuclear energy will increase hereafter, and when the solution is considered to be the above mentioned light water ractor which is predominant today, then efforts must be directed at perfecting light water reactor technology if this energy is to fulfill our hopes.

A review of the world's light water reactor manufacturers (Table 2) shows that Westinghouse and General Electric are overwhelmingly top ranking in technology and market shares. Combustion Engineering and Babcock and Wilcox are developing submarine-use nuclear reactors on the main body with an independent technique. Other representative light water reactor manufacturers are KWU of West Germany, FRAM·ATOM of France and ASEA-ATOM of Sweden, but the light water reactor technologies of KWU which developed a PWR independently both with WH's technology as base and ASEA-ATOM which developed a BWR independent of GE have drawn world recognition.

Table 2. Representative Light Water Reactor Manufacturers of the World

Name of Country	United States			
Name of manufacturer	GE	WH	CE	B&W
Reactor type	BWR	PWR	PWR	PWR
Orders fulfilled	62 units 61,320,000 KW	72 units 70,070,000 KW	31 units 33,230,000 KW	27 units 27,830,000 KW
Name of country	W. Germany	Sweden	France	
Name of manufacturer	KWU	ASEA·ATOM	FRAM·ATOM	
Reactor type	PWR, BWR	BWR	PWR	
Orders fulfilled	25 units 23,540,000 KW		38 units 39,450,000 KW	

Statistics on orders are as of late 1979

But the light water reactor manufacturers of the different nations, with the exception of France, have postponed their nuclear power construction plans, cancelled orders, etc., and are faced with difficulty in operations.

As to the FBR in Japan, the experimental reactor "Joyo" reached critically in 1977, construction of the prototype reactor "Monju" (300,000 KW) is imminent, the "Fast Neutron Engineering Co., Ltd." was established in April of this year with four manufacturers, and the FBR development structure is about to be organized. But until the FBR development structure is about to be organized. But until the state of practical application is reached with FBR, the prototype reactor must be followed up with the construction of a demonstration reactor of practical use size, followed by the construction of several units of early stage practical application reactors, and efforts must be directed for a smooth transition to practical application.

Table 3. FRB Development in the World

Name of Countries	Name of Reactors	Principal Developer	Order Placed By	Operator	Designer or Receiver of Order	Source of Capital
France	Prototype Phenix	CEA	CEA	EDA	GAAA	Total investment by the government CEA 80% EDF 20%
	Demonstration model Super-Phenix	CEA	International consortium NERSA	NERSA	Manufacturers' consortium NOVATOME (France) Manufacturers' consortium NIRA (Italy)	International joint investment EDF 51% ENEL 33% SBK 16%
Great Britain	Prototype PFR	UKAEA	UKAEA	UKAEA	NPC	Total investment by the government
West Germany	Protype SNR-300	Agency for 3 countries (West Germany, Belgium and Holland)	Electric power consortium of 3 countries SBK	SBK	Manufacturers' consortium INB	Government, electrical companies and other manufacturers
United States	Demonstration model CRBR	DOE	DOE	TVA	Principal contractor	Government, electrical companies and other manufacturers
Japan	Experimental model "Joyo"	Power Reactor and Nuclear Fuel Development Corp.	Power Reactor and Nuclear Fuel development Corp.	Power Reactor and Nuclear Fuel Development Corp.	Hitachi, Ltd., Toshiba Corp., Mitsubishi Heavy Industries, Ltd. and Fuji Electric Co., Ltd.	Total investment by the government

In the world today, France is the most advanced in FBR development (Table 3) and it is in the midst of constructing the 1.2 million KW demonstration reactor "Super-Phenix." Regarding nuclear reactors, it must be borne in mind that importing reactors intact that are developed abroad will involve many facets, such as the earthquakeproofing factor that may not necessarily be easy, and so efforts must be directed for an early and independent development of FBR.

After the shares of the government and private industries in the funds to construct the prototype reactor "Monju" are clearly delineated, the direction as to the development structure after the demonstration reactor following the "Monju" and on the subject of development, orders, raising construction funds, etc., must be resolved quickly and clearly.

Electronic Computer Industry

Tokyo KOGYO GIJUTSU in Japanese Vol 21, No 6, Jun 80 pp 36-45

[Article by the Electronic Apparatus and Electrical Section, Machinery and Information Industries Bureau, MITI]

[Text] 1. Progress of the Electronic Computer Industry

An electronic computer is an aggregate of system technologies that is realizable only after the development of advanced electronic and machinery engineering, and it is made with the most sophisticated electronic and machinery technologies of that era. The world's first electronic computer was made at Pennsylvania University by Eckert and Mauchly who developed the vacuum tube type ENIAC. In Japan, the University of Tokyo, the Electrotechnical Laboratory of MITI and the Electrical Communications Laboratory of the Nippon Telegraph and Telephone Public Corporation began development about 10 years after the United States.

Generally the development stages of the electronic computer are classified as generations depending on the type of element used in the electronic computer. (Table 1) The first generation was vacuum tube; the second generation, transistor; the third generation, integrated circuit (IC); the third and a half generation uses the LSI as element and the next generation will use an element made from microscopic processing, called VLSI. The computer has gradually become easy to operate with progress in the hardware along with the basic software or operating system of each generation. (Table 1)

The present state of the art is in the second half of the third and a half generation and the principal types are the IBM 370 series, the 303X; and the Japanese manufactured M-series, ACOS-series, COS MO-series, etc. The two types of the IBM 4300 series which were announced in January of last year are considered forerunners of the fourth generation and beyond doubt the transition into the fourth generation is imminent.

2. The Present State of the Electronic Computer Industry

The Japanese electronic computer industry has progressed satisfactorily and the production amount of apparatus related to the electronic computer industry has not only exceeded 1 trillion yen, but the number of general use electronic computers

Table 1. Electronic Computer Technology and Its Generations

Generations	Processing method	Hardware	Basic Software (Operating System)
First generation (up until 1960)	With assistance	Vacuum tube	Loader (Operate by reading machine address instructions) Assembler programming system (Translation of language through symbols by machine address instructions) FORTRAN programming system
Second generation (up until 1964)	Local batch processing	Transistor	Continuous processing of job (Translation of scientific language) ALGOL compiler (translation of business calculation language) COBOL compiler (Input/output control) IOCS
Third generation (up until 1970)	Multi-programming processing	IC	Multiple processing of job (Parallel processing of several jobs) Time sharing processing (Time sharing conversational type processing) PL/I compiler (Translation of general language) Data management (Control of diversified input/ouput apparatus)
Third and a half generation (the present)	Online processing	MSI-LSI	Job schedule management (Manage processing order of jobs) Online management (Control of diversified terminal apparatus) Virtual memory management (Technology to make large program executable over that of true memory)
Fourth generation (the future)	Composite distributed processing by user's directions	VLSI	RASIS function (Guarantees confirmation of system movements) Virtual machine function (Virtual calculator function) Network management (Exchange of voluminous data between several systems) Processing characters, graphic symbols, images and the Japanese language (from data processing to information processing) Function to process super advanced language (Anyone can use the computer for advanced purposes)

in actual operation (Figure 1) is 61,687, as of late June 1979, making Japan second ranking in the world.

On export and import trends (Figure 2), exports at the end of 1979 totalled 80.9 billion yen and imports 154.3 billion yen, showing a continued unfavorable trade balance, and the year 1979 (sic) will result in a bigger deficit. But since a part of the exports consists of products manufactured by foreign-affiliated corporations, exports by domestic electronic computer manufacturers are about to be increased, by the amount is still small.

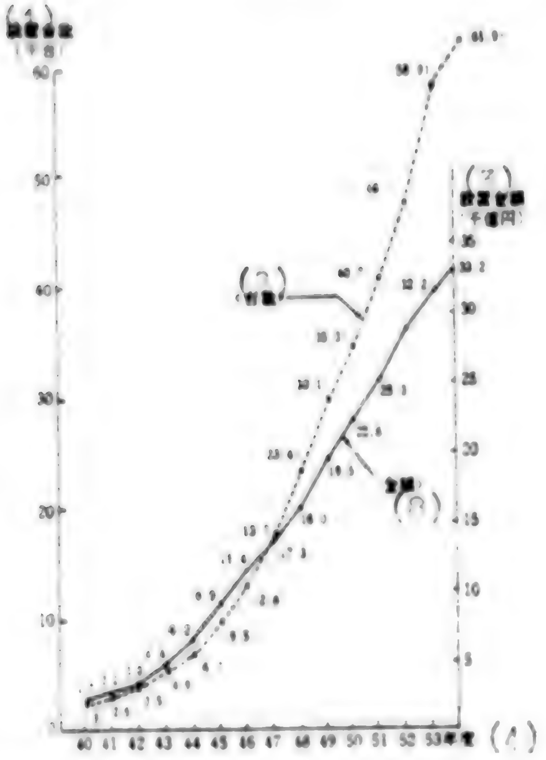


Figure 1. Status of General Use Electronic Computers in Actual Operation

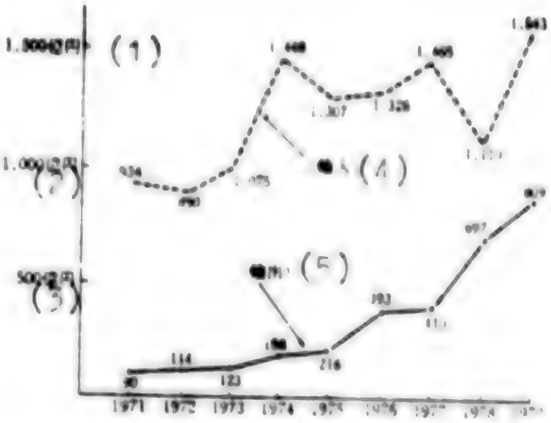


Figure 2. Computer Exports and Imports

Source: Finance Ministry's Customs Statistics

Key:
(1) 150 billion yen
(2) 100 billion yen
(3) 50 billion yen
(4) Imports
(5) Exports

Source: MITI's "Survey on Goods Delivered"
As of late June 1979: Value: 3,315,982 million yen
Units installed: 61,687 units total value

As described above, the electronic computer manufacturers are about to make a start on the fourth generation and IBM has already announced three types of medium and small size computers of the so-called E-series. Moreover, it is reported that IBM is scheduled to announce the H-series of large-size computers. In answer to this, other foreign-affiliated corporations have successively announced computer types to compete against the E-series and therefore domestic manufacturers are rushing to develop competitive types.

Table 2. Programs to Promote the Information Industry

				(Budget for FY 1979)	(Budget planned for FY 1980)
To promote the information industry To accelerate use of information	To promote hardware	1.	Subsidies to accelerate the development of an electronic computer with the next generation	(8.61 billion yen)	(5.785 billion yen)
		2.	Development Bank loan to the Japan Electronic Computer Co., Ltd.	(within 50 billion yen)	(within 48 billion yen)
		3.	Development Bank loan for structural improvement	(within 50 billion yen)	(within 48 billion yen)
		4.	Special redemption fund for high performance electronic information remote processing apparatus	-	-
	To promote software	1.	Software production technological development plan	(1.52 billion yen)	(1.67 billion yen)
		2.	Subsidies for operational expenses of The Council for the Promotion of Information Processing (includes above 10)	(2.58 billion yen)	(2.78 billion yen)
		3.	Financial measure for information processing promotion (underwrite bank debenture)	(7 billion yen)	(5 billion yen)
		4.	Development Bank loan to nurture technicians for software development and information processing	(within 50 billion yen)	(within 48 billion yen)
		5.	Reserve fund system for general-use software development	-	-
		6.	Reserve fund system for program guarantee	-	-
	To advance systems development	1.	Development of pattern information processing system (large-scale project of the Agency of Industrial Science and Technology)	(2.8 billion yen)	(1.846 billion yen)
		2.	Development of a health care network system	(190 million yen)	(220 million yen)
		3.	Development of a substitute energy type community energy system	(9 million yen)	(42 million yen)
		4.	Development of a trade information system	(25 million yen)	(34 million yen)
		5.	Development Bank loan to accelerate usage of information processing system	(within 50 billion yen)	(within 48 billion yen)
	Basic preparation to use of information	1.	Survey on the actual state of information processing	(16 million yen)	(16 million yen)
		2.	Survey on statistics of electronic computer orders fulfilled	(5 million yen)	(5 million yen)
		3.	Survey on industries by classification converting to systems	(2 million yen)	(2 million yen)
		4.	Survey on legal protection of software	(6 million yen)	(6 million yen)
		5.	Program survey record	(2 million yen)	(2 million yen)
		6.	Information processing technicians' exam	(62 million yen)	(6[illegible] million yen)
		7.	Comprehensive survey on problems of information processing technicians	(2 million yen)	(2 million yen)

[Table 2 continued]

8. System to reduce taxes from educational and research expenses for information processing technology		
9. Safety measures for the information processing services	(0 million yen)	(2 million yen)
10. Safety measures for software, etc.	(700,000 yen)	(700,000 yen)
11. Loan system to accelerate safety measures for the electronic computer system (Development Bank) (medium and small financial institutions)	(within 50 billion yen for Development Bank) (3 billion yen for medium and small financial institutions)	(within 48 billion yen for Development Bank) (3 billion yen for medium and small financial institutions)
12. Register system for the information processing service business	(1 million yen)	(1 million yen)
13. Information changeover week	(400,000 yen)	(400,000 yen)
14. Subsidies to introduce electronic computers to Chambers of Commerce and others	(127 million yen)	(190 million yen)

3. Promotional Measures of the Electronic Computer Industry

Because the electronic computer industry, besides being an extremely advanced and knowledge-intensive industry, can bring about the increase of productivity in manufacturing and business of other industries through the use of electronic computers, it is an industry that can contribute to the advancement of Japan's industrial structure. Moreover, because the technologically rippling effect of the electronic and machinery industries, information processing industry, etc., is enormous, and because it can contribute to nurture new industries such as the data base industry, systems industry, etc., this industry can become Japan's leading industry in the 1980's. To achieve this and in order to facilitate the advancement of the electronic computer industry, the government adopted various measures, as shown on Table 2, to promote information processing.

The program on subsidies for expenses to advance the next generation electronic computer development is to promote technological development need for the fourth generation electronic computer and assistance has been given to private interests to conduct technological development on VLSI and basic technologies.

The VLSI development project was a 4-year plan, beginning in FY 1976, and development was undertaken at the VLSI Technology Research Association which developed a technology of submicron processing as pertains to (1) microscopic process technology, (2) crystal technology, (3) design technology, (4) process technology, (5) test evaluation technology and (6) device technology. The subsidy program was concluded at the end of March 1979.

One of the results achieved by this VLSI development project is the 256 K bit RAM which was announced at the ISSCC held recently in San Francisco. (A portion of the results was presented in "This month's photograph" in the May 1980 issue of this magazine.) Hereafter, with the 4-year results as basis, the various companies will independently develop electronic computers packaged with VLSI.

The development of basic technology for the next generation electronic computer program was launched as a 5-year plan from FY 1979 with a total operating outlay of 47 billion yen to technologically develop a new peripheral terminal apparatus that would handle the Japanese language and basic software called operating systems. The technological development will be undertaken by the Electronic Computer Basic Technology Research Association which consists of Japan's computer and peripheral terminal manufacturers. The contents of the technology development are as follows:

(1) Basic Software

(i) Control program

(1) Basic technology

Basic technology is the development of such technology as one level storage management that would make the main storage and secondary storage uniformly accessible, a capability to prevent, detect and quickly recover abnormal movements of the electronic computer system, RASIS function to strengthen and perfect the secrets protection capability, and a resource sharing system to devise the effective use of the various resources. (Figure 3)

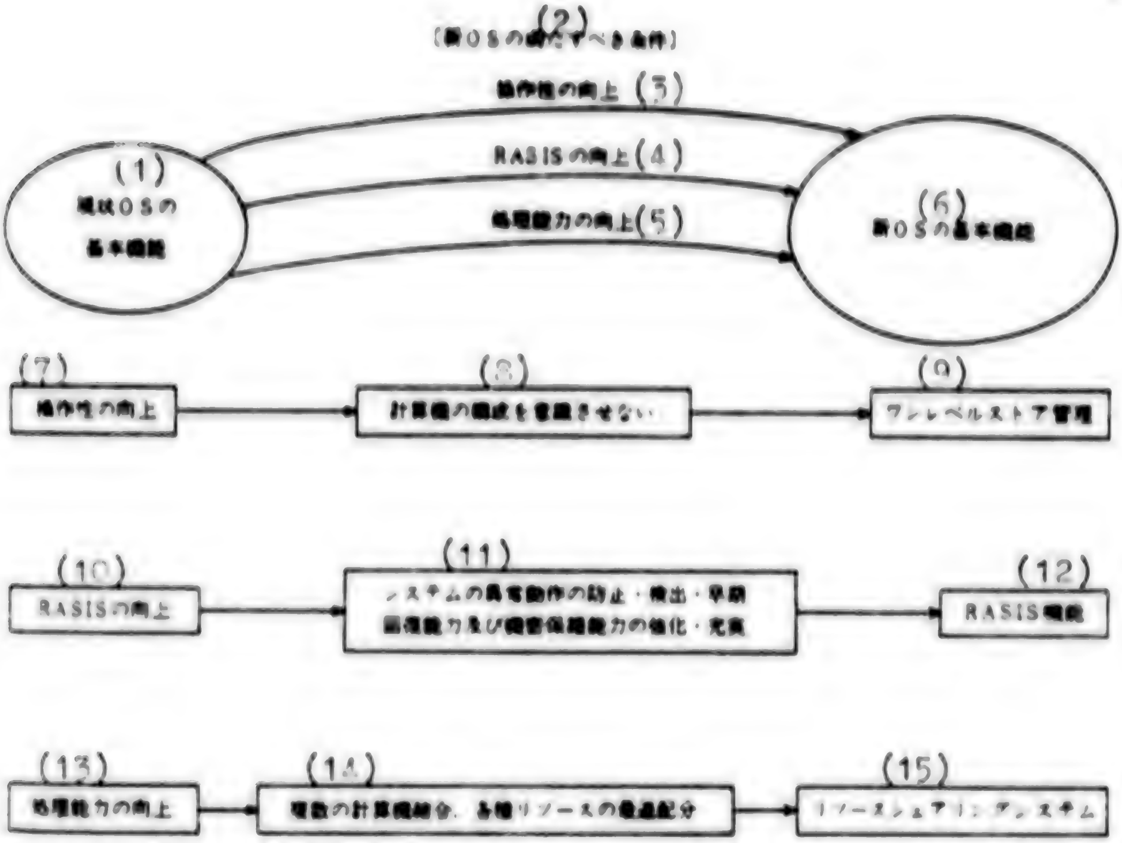


Figure 3. Basic Technology

Key:
(1) Basic functions of present day operating system
(2) Conditions that must be fulfilled by the new operating system
(3) Upgrading manageability
(4) Upgrading RASIS
(5) Upgrading processing capability
(6) Basic functions of new operating system
(7) Upgrading manageability
(8) Composition of the computer is deliberately avoided
(9) One level storage management
(10) Upgrading of RASIS
(11) Strengthen and complete the capability for prevention, detection and early recovery of abnormal movements of the system and the capability for security maintenance
(12) RASIS functions
(13) Upgrading of processing capability
(14) Linkage of several computers and the ideal distribution of various resources
(15) Resource sharing system

(2) Network management technology

Since it is essential to have a sophisticated electronic computer network to go along with the technological innovation of a data communications network, develop an operating system alongside the computer to realize a network management technology so as to plan for the effective use of the system sources, etc. (Figure 4)

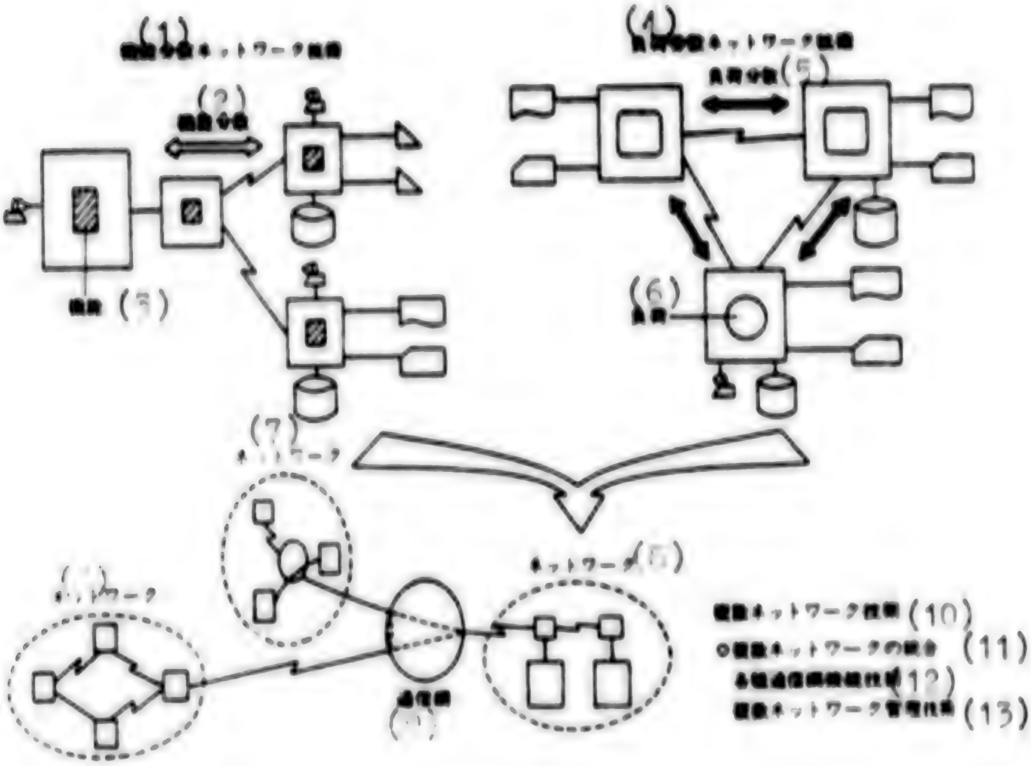
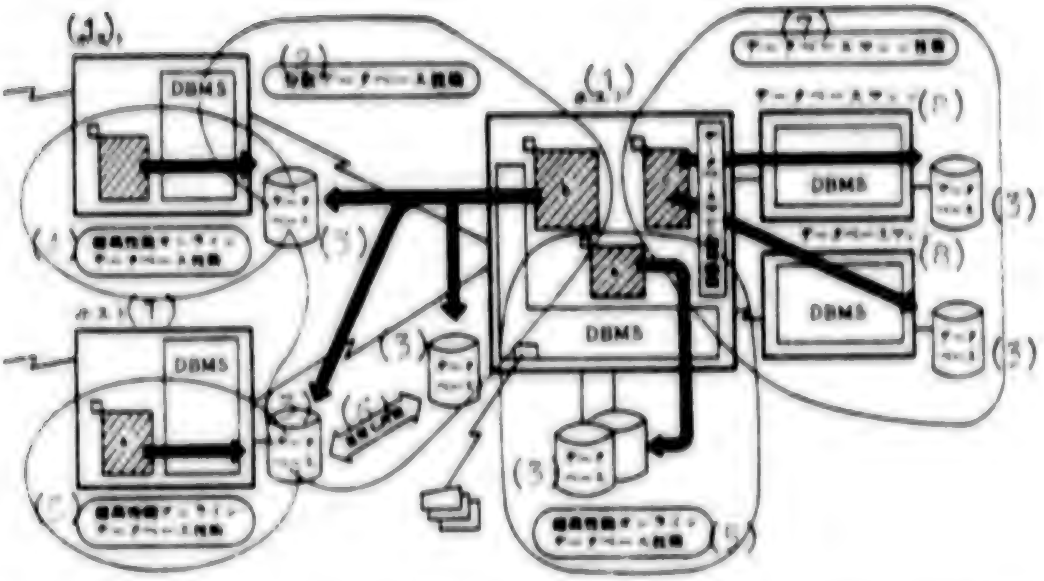


Figure 4. Scheme of Network Technology

Key:
(1) Network technology of distributed function
(2) Distributed function
(3) Function
(4) Network technology of load distribution
(5) Load distribution
(6) Load
(7) Network
(8) Network
(9) Communication network
(10) Multiple network technology
(11) Integration of multiple network technology
(12) Technology to connect several communications networks
(13) Multiple network management technology

(3) Data base management technology

Develop a data base management technology that would increase the efficiency level of data base processing so as to cope with an enlarged capacity of the data base and sectional decentralization. (Figure 5)



Oblique lines indicate applications programs. a. using very high performance online data base technology, b. using distributed data base and c. application program using data base machine technology

Figure 5. A Comparison of Data Base Technology, Very High Performance Online Data Base Technology and Distributed Data Base Technology

Key: (1) **Host**
(2) Distributed data base technology
(3) Data base
(4) Very high performance online data base technology
(5) Very high performance online data base technology
(6) Overlapping is possible
(7) Data base machine technology
(8) Data base machine

(4) Virtual Machine Technology

In order to make the user's varied applications available, develop a virtual machine technology that would result in several units of virtual computers with one unit of an electronic computer system as basis. (Figure 6).

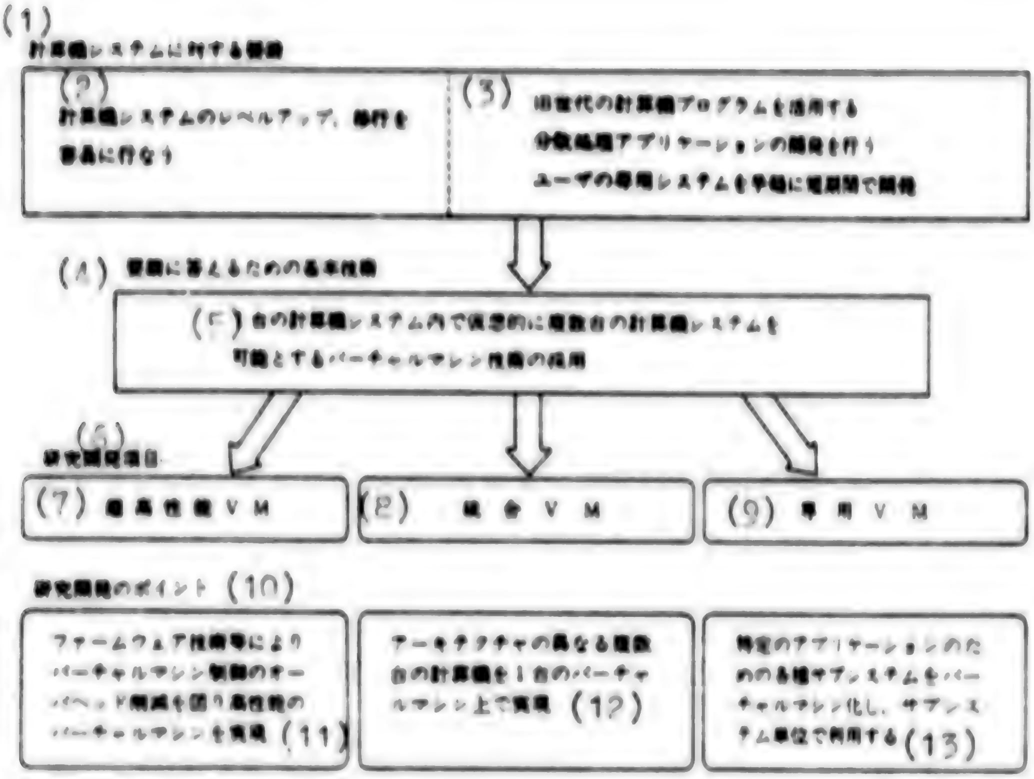


Figure 6. Virtual Machine Technology

Key:
(1) Requirements of a Computer System
(2) Raise the standard of the computer system with smoother movements
(3) Apply the computer program of the previous generation
Develop distributed processing applications
Develop the user's special system readily in a short time
(4) Basic technology to meet requirements
(5) Utilize a virtual machine technology that would make it possible for multiple units of a computer system to be virtually used within one unit of a computer system.
(6) Topics for research and development
(7) Very high performance V M
(8) Integrated V M
(9) Specialized V M
(10) Essentials of research and development
(11) Achieve high performance virtual machining by contriving for overhead reduction with virtual machine control through (formware) technology, etc.
(12) Make it possible for multiple units of a computer with a different architecture placed over one unit of virtual machine
(13) Use subsystem units by virtual machine conversion of various subsystems for specialized application

(ii) Super class language processing

(1) Super class language processor

Along with the accelerated popularity of electronic computers, the end user's demand for an application program development has increased. To cope with this demand, develop a super class language processor that would be used as a tool to assist the end user's work. (Figure 7)

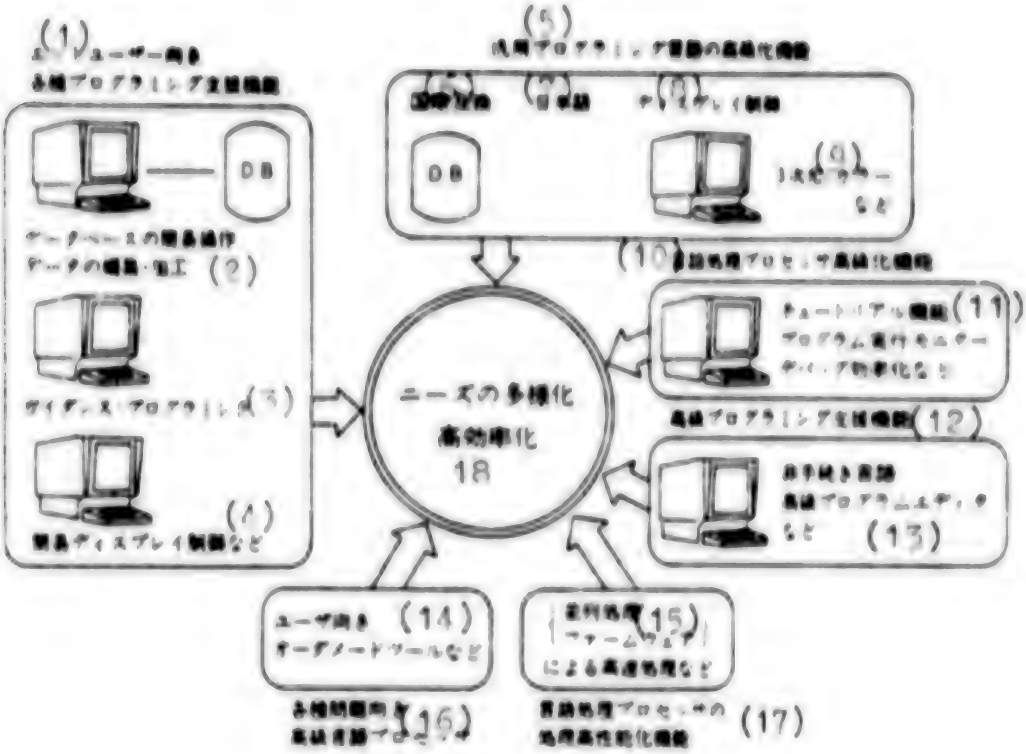


Figure 7. Language processor

Key:
(1) Made for the end user; support function for various programs
(2) Simple manipulation of data base; data editing and processing
(3) Guidance programming
(4) Simple display control, etc.
(5) Function to upgrade general use programming language
(6) International interchange
(7) Japanese language
(8) Display control
(9) Three dimensional/color, etc.
(10) Function to upgrade language processor
(11) Tutorial function; program executing monitor; debug efficiency conversion, etc.
(12) Higher level programming support function
(13) Non-procedural language; higher level program editor, etc.
(14) Made for the user; custom made tools, etc.
(15) Parallel processing; (formware); based on high speec processing, etc.
(16) Made to solve various problems; higher level language processor
(17) Function to upgrade high performance of language processors
(18) Diversification of needs; upgrading to higher efficiency

(2) Japanese language information processing technology

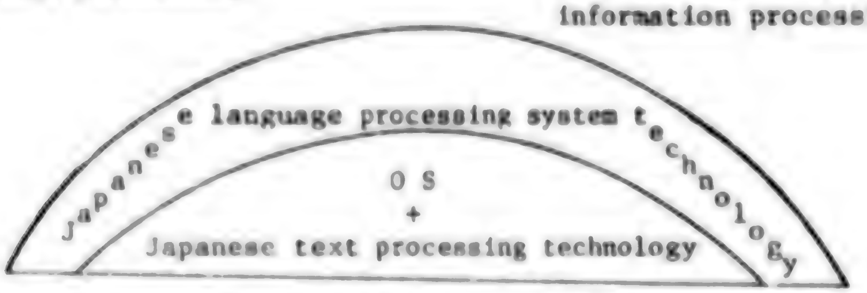
Develop a Japanese language information processing technology to install a standard function of the operating system having the basic function to process Japanese text, and to develop a Japanese language processing systems technology with which to develop a pilot plant for Japanese language information processing. (Figures 8 and 9).

(2) New Peripheral Terminal Technology

(i) Japanese language input-output technology

To develop a kana, Chinese charter input apparatus technology that would convert kana inputs automatically into Chinese characters as an input-output (I/O) technology with direct access to the Japanese language, a Japanese language voice input apparatus technology that would have a direct voice input, a Chinese character OCR that would make inputs of written Chinese characters possible, and a Japanese language printer technology for Japanese text at super speed, high quality and with multi-functions.

Technology topics	Japanese text processing technology	Japanese language processing system technology
Technology of software on subject matter	Software technology to incorporate the standard functions of the operating system for Japanese language processing	A system technology that is essential for a pilot system and software in order to disseminate Japanese language information processing


Japanese language processing system technology
O S
+
Japanese text processing technology

Substantive content	o Chinese character basic processing technology o Technology to control Japanese language input-output apparatus o Technology to change kana and Chinese character sentences from the host side of the operating system o Technology to manage the Japanese language file o Technology to edit Japanese language text	o Japanese language information processing, Data base management technology o An integrated editor technology to include graphics and Japanese language sentences o Office automation technology o Pilot system

Figure 8 Japanese Language Information Processing Technology

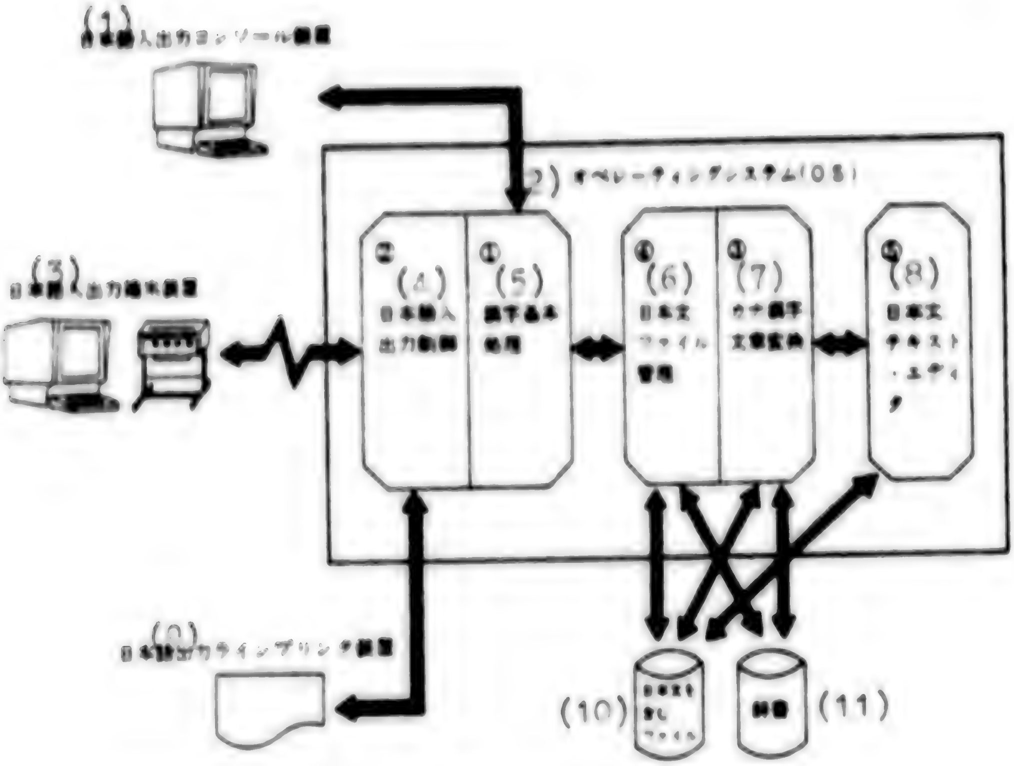


Figure 9. Japanese Text Processing Technology

Key:
- (1) Console apparatus for Japanese language input/output
- (2) Operating system
- (3) Japanese language input/output terminal apparatus
- (4) Japanese language input/output control
- (5) Chinese character basic processing
- (6) Japanese text file management
- (7) Conversion of kana and Chinese character sentences
- (8) Japanese text editor
- (9) Japanese language output line printing apparatus
- (10) File which includes Japanese text
- (11) Dictionary

(ii) Japanese language external storage technology

Develop a super large capacity and super high speed magnetic disk apparatus technology and a large capacity magnetic bubble apparatus technology for inputs of Japanese text.

4. Development of Electronic Computer Technology

(1) New Device Technology

Any change in the generation of an electronic computer system is dependent on device technology. Research on new devices requires that, from the standpoint of the element, research on the basic element material and on the technology to functionalize the results of the element, and from the standpoint of devices, research on the functional module as an extension of the functionalizing technology must be undertaken.

As for the silicon element which is the mainstay today, the research and development expenses that must be paid for upgrading its performance in the research and development stage has increased index and functionwise and with the progress in VLSI, its physical limitations can be foreseen. Therefore, as the logical element and memory cell to be used on future electronic computers, research on new element materials of high speed and high density must be undertaken.

(i) GaAs Semiconductor Element

Since the mobility of the conductive electric charge of most of the compound semiconductors is greater than that of silicon, it is possible that their electrical characteristic is superior than that of silicon. The semiconductor with advanced development today is GaAs which is a field effect transistor using the (metaru) Schottky gates whose high speed rate has been recognized. Special features of GaAs element are as follows: (1) Its electronic mobility of 4000 cm^3/Vsec is greater than the 1000 cm^3/Vsec for silicon, (2) the distributing capacity is low because of the distributing possibility on the semi-insulating plate, (3) the possibility for high speed motion exists because separation between elements is possible and (4) its simple structure and separation factor make it suited for high integration. It is reported in the United States that a 10-20 gate unit has a computing speed of 100 to 300 psec, power consumption of 200 to 3,000 μw/gate, and in particular a high speed unit of about 50 psec.

But because of the paucity of research data accumulated in the past, on GaAs element, as compared with silicon, research activity on a wider scale must be conducted, e.g. on materials technology: base plate improvement technology, epitaxial technology, impurities control technology, ion implementation, and hetero-epitaxial technology; on materials evaluation technology: technology to evaluate semiconductor base plate epitaxial interface, etc.; on device manufacturing technology: Schottky type FET manufacturing technology, microscopic processing technology, insulating membrane preparation technology and (various growth) preparation technology; on integration-conversion technology: integration technology, circuit structure technology and design technology and design technology. Anticipated characteristics when it will be used as the logical element of an electronic computer are:

a. gate count: 200 to 1,000

b. computing speed: 50 to 100 psec

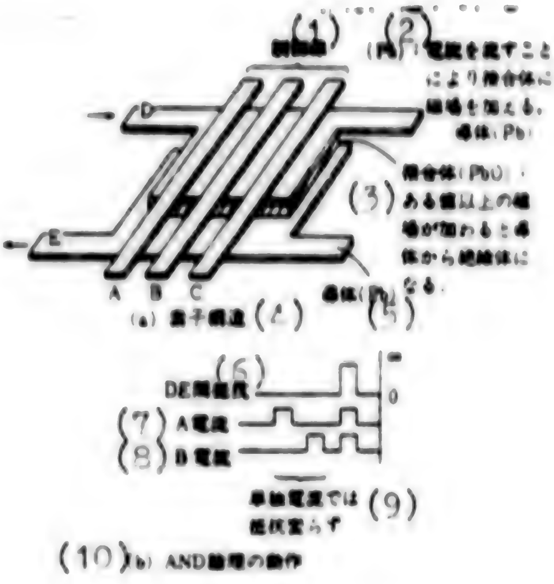
c. power consumption: 10 to 1,000 mW/chip

As for packaging, if the convertibility of the silicon bipolar element, as used in the past, can be guaranteed, the use of GaAs in the system is close by.

(ii) Josephson element

Because the switching feature of the Josephson element is exceptionally superior, the prospects are bright that it will be used in the construction of the electronic computer of the future. (Figure 10)

Figure 10. Josephson's Logical Element



Key:
- (1) Control lines
- (2) An electric flow creates a magnetic field over the connector. Conductor (Pb)
- (3) Connector (PbO) If the magnetic field exceeds a certain value, then the conductor becomes insulated
- (4) Structure of element
- (5) Conductor
- (6) Resistance between DE
- (7) A current
- (8) B current
- (9) Resistance will not change with an independent current
- (10) Movement of AND logic

Some of its outstanding features are: (1) The speed of the on/off movement of the connector is 1 o r 2 digits faster than that of the semiconductor element, (2) power consumption is 1 to 3 digits less than that of a semiconductor because of its superconductive element, (3) it is suited for high integration because of its simple structure, (4) will not move unless it is at low temperature. These outstanding features are epoch making when compared with the semiconductors used heretofore. And because it can be used both as a logical element and a memory element, it is possible to construct an electronic computer with only the Josephson element.

IBM is engaged vigorously in research on the Josephson element by developing a unit with a gate count of 10 to 50, computing speed of 50 to 500 psec and power consumption of about 10μW/gate. Even in Japan, several firms have begun research from FY 1980 with research and development subsidies on essential technologies.

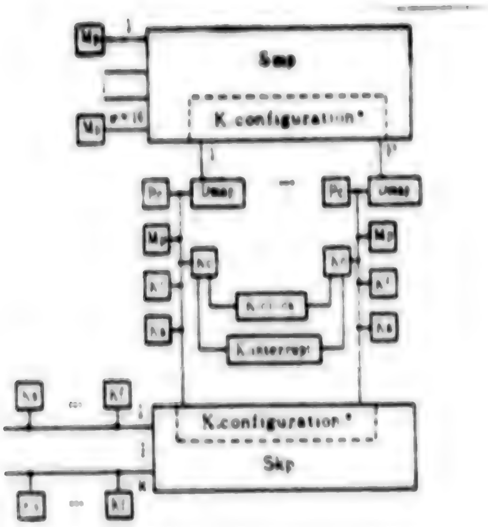
Before achieving practical utilization of this element, research and development on a considerably wide scale, from fundamentals to application, must be undertaken.

(1) Materials technology: Develop an element having a high critical temperature, using the Josephson element.

(2) Manufacturing technology: Technology to manufacture a binder (connector) with a recall feature and an element structure that can withstand a temperature cycle.

(3) Design technology: Design technology most suited for an element; circuit structure technology; technology linked with normal temperature conditions and packaging technology as a sytem.

(4) Refrigeration technology: Low temperature technology with high efficiency.



Pc: processor; Ks: low speed device control Dmap: address conversion
Mp: main memory; Kf: high speed device control; Smp: switches
T : Terminal; Kc: control by clock, etc.; K.configuration: configuration control
K.clock: clock control
* Both switches are manual; program control is possible; K.interrupt: interruption control

Figure 11. Schematic of C.mmp System

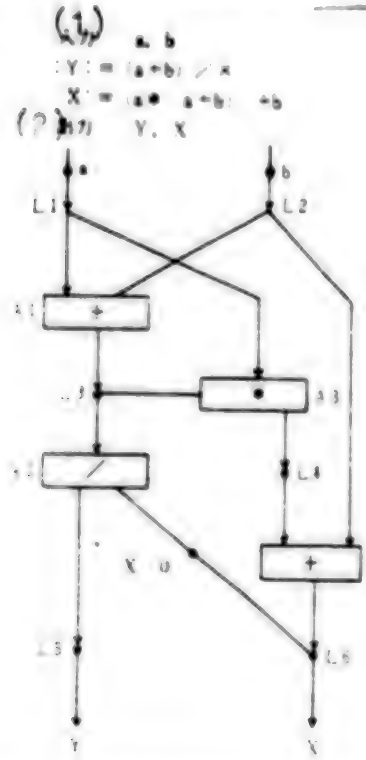


Figure 12. Fundamental Data Flow Program

Key: (1) input
(2) output

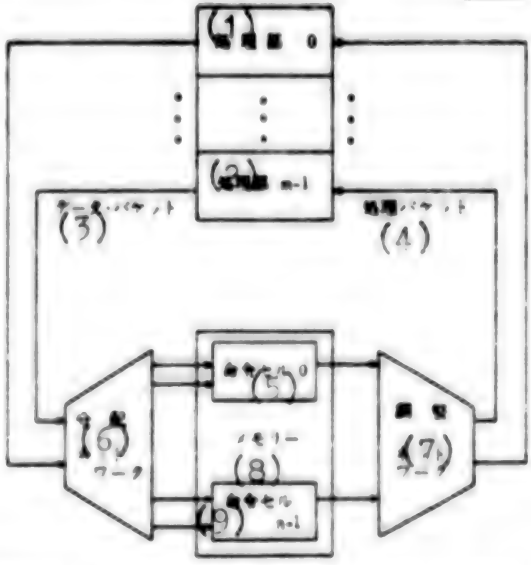


Figure 13. Basic Schematic of Data Flow processor

Key: (1) processing section
(2) processing section
(3) data bucket
(4) processing bucket
(5) instruction cell
(6) distribution network
(7) regulation network
(8) memory
(9) instruction cell

Many problems must be solved to realize this sort of practical application, but it is felt that on attaining practical application, its performance will render the electronic computer with epoch making improvements. Such making improvements. Such an element will possess the following characteristics:

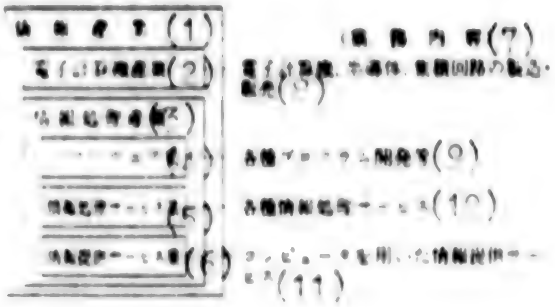
a. gate count: 100 to 1,000

b. computing speed: 10 to 100 psec

c. power consumption: 0.1 to 100 mW/chip

d. memory count: more than 10^9 bit

e. access time: less than 10 nsec



(2) New Architecture

Since the processing efficiency of electronic computers that were based on sequential processing heretofore was had and so as to cope with the demands of information processing that will increasingly have multifarious uses hereafter, research must be conducted on processing apparatus that will have a high efficiency for adaptation to various applications. This type of new processing apparatus indicates the realization of the so-called non (noiman) function, of a processing apparatus and large capacity data base which use a parallel processing apparatus, data flow processing apparatus, associative processing apparatus, list processing apparatus, and learning and reasoning functions.

(1) Parallel processing apparatus

Like the multiprocessor system of consolidating several electronic computers to process data with independent operational units, the famous C.mmp system of 16 minicomputers consolidated with crossbar switch is used. (Figure 11). Two types of development with differing objectives on parallel processing apparatus are undertaken. The first, focused on large scale scientification with the partial differential equation, is to develop a very high performance parallel processing apparatus which centers on numerical processing that would contribute to the progress of practical application involving a great deal of computing. Fluid mechanics, structural computation, nuclear power engineering are some of the disciplines with high requirements for parallel processing apparatus. The other type is to develop a parallel processing apparatus for non-numeric processing that would contribute to the expansion of application in graphics and image processing.

As a condition to the effectiveness of parallel processing, software must be developed for high speed logic, high speed memory element, processing descriptive language, automatic search for parallel processing, algorithm suited for parallel processing, etc.

(ii) Data flow processing apparatus

The data flow processing apparatus is an electronic computer than basically has a program structure that is data oriented with architecture and it has considerable differences with the (fon noiman) type computer which is program oriented or the control oriented type used heretofore. (Figures 12 and 13) The principal characteristics are: (1) The emphasis on the (fon noiman) computer is flow of control and data operation is based on this flow, but with the data flow processing apparatus, the emphasis is on flow of data and processing is done while the data is operated on. (2) In data flow processing, the flow of data that can be parallel processed is recorded and processed by means of the parallel processing structure. (3) The operational units have different levels, ranging from such basic operations as the arithmetical (add, subtract, multiply and divide) to such high functions as the functional operations. Such classifications as large scale scientific computation, signal processing, graphics and image processing have taken advantage of these characteristics in application. The program is easy to prepare if the operating units are established on a high functional level, thereby raising its program productivity. With past program languages, there are such advantages as only complex descriptions could be made and at the same time parallel movements in natural description can be described.

Research on data flow processing apparatus is actively conducted in the United States, Great Britain and France, principally at universities and well known are Massachusetts Institute of Technology, University of California and Burroughs at the Utah University. However, at the present time it is difficult to predict the role of the data flow processing apparatus in the information processing system of the future, and hereafter to develop a data flow apparatus, the main objective should be to develop a data flow processing apparatus for the primary purpose of supplementing the general purpose computer for a specific application, and it is hoped that studies will be made on the convertibility and switchover of general purpose units or programs used heretofore.

5. The Future of the Electronic Computer Industry

With the announcement of the 4300 series (E series) by IBM, the electronic computer is at the threshold of utilizing the fourth generation element. It is reported that the announcement of the H series, which is the higher grade in the E series, will be made this year and next year, and said announcement will herald the formal entry of the fourth generation into electronic computer use.

And with the announcement possibly as early as 1983 of electronic computers equipped with the fourth generation element to be derived from VLSI development and other basic technology development, Japan's electronic computer industry will reach a new turning point in the very near future. Despite these new developments, Japan's electronic computer industry heretofore had grown by adding on to past performances, but in order to achieve higher level upgrading of Japan's industrial structure, untiring efforts in technological development must be exerted hereafter.

Information Processing Industry

Tokyo KOGYO GIJUTSU in Japanese Vol 21, No 6 Jun 80 pp 46-51

[Article by the Information Processing Promotion Section, Machinery and Information Industries Bureau, MITI]

[Text] 1. Development Stages of the Information Processing Industry

(1) The Role of the Information Processing Industry

The information processing industry is divided into the following three parts:

(1) Software service: Prepares programs for use with the electronic computer, on request by others.

(2) Information processing service: Processes information through computation by means of the electronic computer, on request by others.

(3) Information furnishing service: Retrieves and furnishes information by means of the electronic computer, on request by others.

It is the ideal industry for being knowledge-intensive, resource-conserving, energy-saving and non-polluting, and as the nucleus for the highly advanced development of Japan's industrial structure, its growth as an industry is greatly anticipated. (Figure 1)

Information industry	Business functions
Electronic computer industry	Manufacture and sale of electronic computers, semiconductors and IC
Information processing industry	
Software services	Development of various programs
Information processing services	Various information processing services
Information furnishing services	Information furnishing services utilizing computers

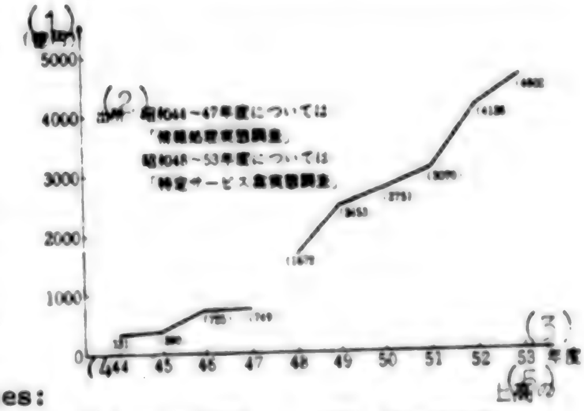
Figure 1. The Role of the Information Processing Industry

(2) History of the Information Processing Industry

Japan's information processing industry was begun in the second half of the 1950's and since then along with the progress in society's acceptance of information usage, it has consistently achieved rapid growth. (Figure 2). Furthermore, with the sudden technological innovation of the information processing technology, its business scope has undergone drastic transformation.

Figure 2. Progress in Sales of Japan's Information Service Industry

Key:
- (1) unit value=100 million yen
- (2) Source: Statistics from 1969 to 1972 were obtained from the "Survey on the Actual State of Information Processing"
  Statistics from 1972 to 1978 were obtained from the "Survey on the Actual State of Exceptional Services:
- (3) Showa year designation
- (4) 44=1969
- (5) 53=1978



The development stages of the information processing industry up to now can be shown in periods of 5 years each and a summary of each period is given as follows:

(1) Second half of the 1950's (birth of the information processing service)

It is said that Japan's first computer center was established in 1954. Reportedly 24 computer centers were established between 1954 and 1961, an average of three centers per year.

This is the period when the industrial world began to make progress by leaps and bounds, after the period of confusion in the post-war years, and along with the increase in the workload from the growth of the operational structure, rationalization of operations became evident; then the electronic computer became the new office equipment to replace the abacus, but because business matters were mostly processed in-house, it can be said that the role of the computer center was wholly to serve as an auxiliary function to the electronic computer user.

On the other hand, the bulk of the supply of software, which is indispensable with the use of an electronic computer, was furnished by the computer hardware supplier (dealer of foreign-made computers and domestic manufacturer) at the time of purchase as an ancillary service, which in most cases was free of charge, and so the business of software production and marketing could not become an independent industry.

(2) First half of the 1960's (birth of the software services)

During the first half of the 1960's, computers with the second generation element were used in a business course on transistors, and the popularization of computers catering to big business was begun with the establishment of the Japan Electronic ComputerCo. in 1961 to serve as a centralized rental agency of domestic manufactured computers. This period flourished with the introduction of scientific operational management techniques on business operations, and with computer adaptation in multifarious ways, such as mechanization of office matters, production management and technology development, the demand for information processing expanded. Along with the growth in computer use and expansion of its adaptations, the demand for information processing increased tremendously; with the gradual high level advancement and specialization of information processing technology, an environment that made it possible for the information processing service to exist as an industry was formed, and the number of computer centers established was of an annual average of about 30 and a total of 145 computer centers was established by 1965. This can be considered to be the era of growth of the information processing service industry.

With the growth in computer use and expansion of its adaptations, the computer users and information processing service personnel could not respond to the needs of information processing over a widely varied field with only the stereotyped processing pattern of software furnished without charge by the computer hardware companies. Then with some dissemination of knowledge and techniques (general purpose language) necessary for software production, the computer users and information processing service personnel gradually became organized to have their key personnel compile their own software, and some of them became organized to specialize in software production and to gain expert knowledge in a specialized processing field, and finally a group engaged in software conversion formed an independent business, the birth of the software houses. (Figure 3)

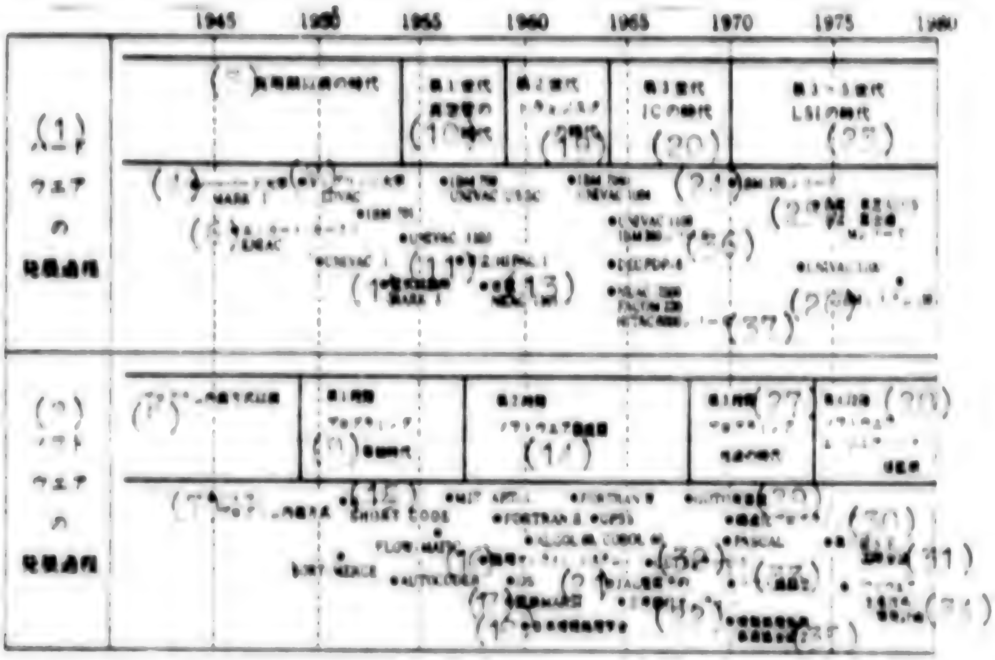


Figure 3. The Development Stages of Hardware and Software (The Present State and Outlook of Software)

Key:
(1) Development stages of hardware
(2) Development stages of software
(3) The era before practical application
(4) Harvard University
(5) Before usage of the stored program
(6) Eckert and Mauchly
(7) (Noiman) Stored program
(8) Cambridge University
(9) First stage; programming; elemental stage
(10) First generation; era of the vacuum tube
(11) Hitachi
(12) Electrotechnical Laboratory
(13) Nippon Electric Co., Ltd.
(14) Second stage: origin of software
(15) (Hoppa)
(16) Commercial use online system
(17) National Railways
(18) Information Processing Society of Japan
(19) Second generation; era of the transistor
(20) Third generation; era of the integrated circuit
(21) Seating reservation of the Japan Air Lines
(22) Online for Mitsui Bank
(23) Third to fifth generation; era of the LSI
(24) IBM 370 series
(25) Nippon Electric Co., Ltd., Toshiba ACOS, Hitachi, Ltd. and Fujitsu Ltd., M series
(26) IBM system /38
(27) Third stage: Programming; era of techniques
(28) Fourth stage: Software engineering; infancy stage
(29) Goto's theory on detriment
(30) Programming with structural changes
(31) First international conference on software engineering
(32) GETSS service
(33) Software Association established
(34) Plan to develop software production technology
(35) Establishment of information processing and furnishing services association

(3) Second half of the 1960's (Period of development)

In entering the second half of the 1960's, the computer prices were lowered with the conversion to the IC element and with the series system, the different types rendered a wider sphere of use. Computer utilization in business was expanded to include such areas as mass production, process management for mass sales, warehousing management, sales management and technology development, and the use of the computer expanded so rapidly as to reach full scale status. For this reason, the demand for information processing increased all the more, and annually 70 to 80 computer centers were established after 1966. In comparison with the number of computer centers established during the first half of the 1960's, the increase was more than twice, and the forms of the organizations were varied. The information processing service industry was now in the state of development and it was recognized by society as a new industry.

And even within the information processing service industry, the software section was gradually assuming the shape of an independent unit, and software development was about to become an important operational part of the information processing service industry.

Because it was not necessary to have a large sum of money as initial capitalization or to have a large staff of personnel to engage in the software service, new participants organized successively and within a short time many software houses were established. However, the general public is still unaware of the value of software services, and since the bulk of software services had been furnished free of charge by the computer hardware dealers, the work of the software houses was equally divided, either by being commissioned by the computer hardware dealer or by direct order from the computer users.

(4) First half of the 1970's (period of stability)

During the first half of the 1970's, Japan's economy was one of stability and growth, and the many computer centers and software houses established during the second half of the 1960's were in a state of doldrum. However, information processing progressed not only as an industry, but also socially and economically, and at the same time the demand for information processing fulfilled varied uses, became highly developed and covered a wide field. As for the information processing service industry, the communication line was opened in September 1971, the public data network was opened in November 1972 and online use was expanded in 1976. Environmental readiness for online information processing was gradually accomplished and the structure of information processing is shifting from the heretofore predominant batch processing to the online remote batch system, indicative of the highly advanced state of the processing structure.

In software, with advancements in the specialization of computer application, specialized products for specific areas have begun to appear on the market, and there have been cases of information processing personnel of computer users of large firms utilizing the software technology to spin out and form independent businesses. Also computer manufacturers, information processing services, etc., have systematized the software houses, and even with the large software houses, there has been a noticeable trend to systematize the medium-small software houses by subcontracting simple operational jobs in the software development process.

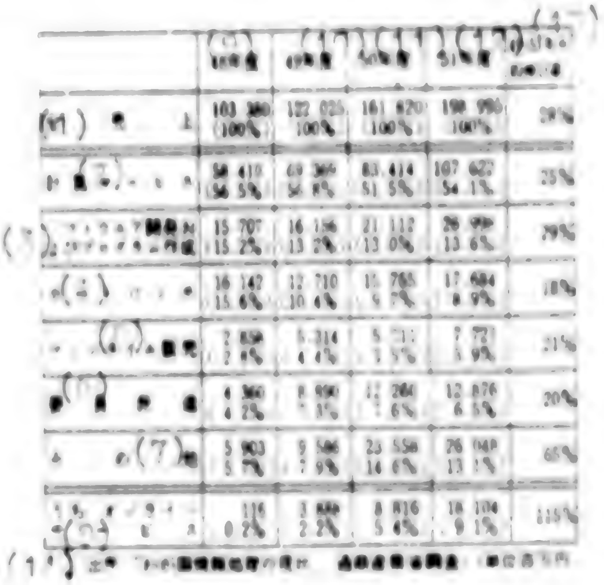
(5) From 1975 on

(a) Full scale operations of the online information processing service

The online information processing service turned full scale around FY 1974, and although considered to be a transitional phenomenon, the annual growth rate since then has been a remarkable 115 percent. (Table 1) The percentage of online information processing service in the total sales of information processing for FY 1976 reached about 10 percent.

Table 1. Progress of the Online Information Processing Services Within the Information Processing Industry

Key:
- (1) Total sales
- (2) Computing services
- (3) Software development and program preparation
- (4) Card punch
- (5) Machine time sales
- (6) Dispatch of personnel
- (7) Others
- (8) Online services
- (9) FY 1973
- (10) FY 1974
- (11) FY 1975
- (12) FY 1976
- (13) Average growth rate between 1974 to 1976
- (14) Source: "The Present State of Japan's Information Processing" "MITI Survey" Unit value in 1 million yen



	(9) [illegible]	(10) [illegible]	(11) [illegible]	(12) [illegible]	(13) [illegible]
(1) [illegible]	103 380 (100%)	122 025 100%	161 820 100%	198 990 100%	28%
(2) [illegible]	58 410 56.5%	69 366 56.8%	83 414 51.5%	107 622 54.1%	25%
(3) [illegible]	15 707 15.2%	16 156 13.2%	21 112 13.0%	26 990 13.6%	29%
(4) [illegible]	16 142 15.6%	12 710 10.4%	15 765 9.7%	17 684 8.9%	18%
(5) [illegible]	2 858 2.8%	5 314 4.4%	5 711 3.5%	7 771 3.9%	21%
(6) [illegible]	4 360 4.2%	8 990 7.3%	11 284 7.6%	12 876 6.5%	20%
(7) [illegible]	5 903 5.7%	9 586 7.9%	23 558 14.6%	26 048 13.1%	65%
(8) [illegible]	116 0.2%	3 666 2.2%	8 816 5.4%	18 104 9.1%	115%

(14) [illegible]

Remarks:
1. The aggregate business is considered to be that of the operations of information processing.
2. Disregarding the small differences in FY 1976, the percentage of total sales of online services, mentioned above, is 83 percent of the total sales of online services for the entire business of information processing operations.

A comparison of the online processing percentages of Japan and the United States is shown on Figure 4. In 1976 Japan's online processing percentage was about 17 percent, but in comparison with that for the United States, Japan is behind by about 10 years.

(b) Birth and full scale operations of the information furnishing services

An information furnishing service will perform retrieval, processing, etc., from the information file with computers, on request by others, and its birth occurred during the latter half of 1965.

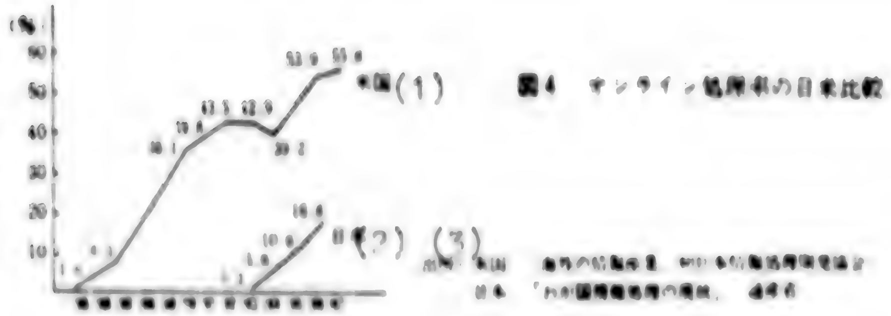


Figure 4. A Comparison of Japan and U.S. Online Processing Percentages

Key: (1) United States
(2) Japan
(3) Sources: U.S. figures were obtained from "The Information Industry Abroad" published by the Japan Information Processing Development Association. Japanese figures were obtained from "The Present State of Japan's Information Processing" published by MITI.

Presently the furnishing services for securities, stock information, economic information, and science and technology publication information are about to reach full scale operations.

2. The Present State of the Information Processing Industry

(1) Scope of Business

As to the scope of business of Japan's information processing industry, small scale business predominate, partly because of the recency of the industry; 50 percent of the firms have an annual sale of less than 100 million yen and 95 percent of the firms have an annual sale of less than 1 billion yen. (Table 2)

Table 2. Percentage of Business Firms in Japan's Information Processing Industry Classified According to Annual Sales Amount

	Below 100 million yen	Between 100 million and 1 billion yen	More than 1 billion yen	Total percentage
1974	62.6%	34.4%	3.1%	100%
1975	57.8	37.7	4.5	100%
1976	53.7	41.4	4.9	100%
1977	51.3	43.9	4.8	100%
1978	49.9	44.8	5.3	100%

Source: "Survey Report on the True State of Exceptional Services" by MITI

(2) Sales and Number of Employees

There were 1,300 business firms in the information processing industry, as of 1978, and indicative of rapid growth was the total annual sales reaching 460 billion yen. The total number of employees was 77,000. (Table 3)

Table 3. Number of Business Firms, Employees and Annual Sales of Japan's Information Processing Industry

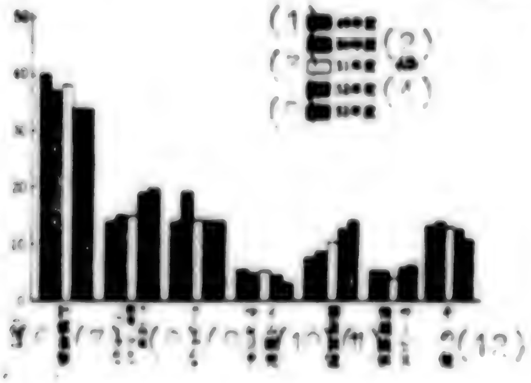
	Number of business firms	Total employees	Annual sales	Per business firm (average)		Annual sales per capita
				Number of employees	Annual sales	
1974	1,322	59*	2,453**	44***	186****	4.2*****
1975	1,276	57	2,751	45	216	4.8
1976	1,276	59	3,070	46	241	5.2
1977	1,640	72	4,126	44	252	5.8
1978	1,672	77	4,602	46	275	6.0
Average growth rate from 1974 to 1978	6.0%	6.9%	17.0%	-	-	-

Source: "Statistics and Survey Report on the Actual State of the Exceptional Services" MITI

* Unit of 1,000 persons
** Unit of 100 million yen
***Unit of person
**** Unit of 1 million yen
*****Unit of 1 million yen

(3) Operations Breakdown

A breakdown of sales by operations showed that computing was the highest, reaching a total of 150 billion yen, followed by software development and program preparation of 89 billion yen and dispatch of personnel of 67 billion yen. A review of the sales operations graph reveals a marked growth in the percentages for software development and program preparation, and dispatch of personnel. (Figure 5)



Key:
(1) FY 1974
(2) FY 1975
(3) FY 1976
(4) FY 1977
(5) FY 1978
(6) Computing services
(7) Software development and program preparation
(8) Card punch
(9) Machine time sales
(10) Dispatch of personnel
(11) Information furnishing services
(12) Others

Source: "Survey on the Actual State of the Specialized Services" by MITI

Figure 5. Past Sales Performances in Percentages of the Various Services of Japan's Information Processing Industry

(4) Difference in Scope of Business Between Japan and the United States

Again a big gap exists in the scope of business in the information processing industry between Japan and the United States. (Table 4)

Table 4. A Comparison of the Principal Software Services in Japan and the United States

	United States (see Remark 1)	Japan (see Remark 2)
Total sales	34 billion yen	4.5 billion yen
Gross profit	2 billion yen	200 million yen
Number of employees	5,528 employees	473 employees

Remark 1. Average of the five principal companies in the United States Computer Science Corporation, Planning Research Corporation, Automatic Data Processing Inc., Informatics, System Development Corporation

Remark 2. Average of 17 representative Japanese software companies which have contributed to the Joint System Development Co., Ltd.

3. Principal Promotional Measures

In recognition of the fact that the information processing industry is not only an essential industry supporting information-conversion, but that it is a model, knowledge-intensive industry that conserves resources, is pollution free and has a high additional value, the government has instituted positive promotional measures. Those in force now are shown on Table 5 and a summary of the principal measures is given as follows:

(1) Operations of the Association to Promote Information Processing Activities

This association was established in 1970 as an agency to assist in promoting program development and use, information processing business, etc., so as to promote information processing through sophisticated use of electronic computers. (Figure 6)

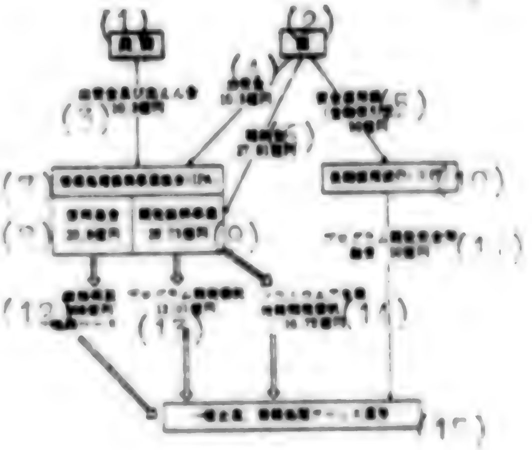


Figure 6. Flow of Operations of the Association to Promote Information Processing Activities As of FY 1980

Key:
- (1) Private
- (2) Government
- (3) Contributing fund or participation fund 1.03 billion yen
- (4) Contributing fund 1.05 billion yen
- (5) Fund management section Underwrite bank debentures 5 billion yen
- (6) Subsidies 2.781 billion yen
- (7) Association to Promote Information Processing Activities
- (8) Credit fund 2.08 billion yen
- (9) Activities to promote development
- (10) Long-term credit bank
- (11) Financing such as program development funds, etc. 3 billion yen
- (12) Suretyship obligation 20.8 billion yen (based on balance)
- (13) Program development consignment 1.201 billion yen
- (14) Consignment for technological development of software production 1.672 billion yen
- (15) Business in general, information processing services, etc.

Table 5. List of Programs to Promote the Information Industry

			(Budget for FY 1979)	(Budget planned for FY 1980)
	To promote hardware	1. Subsidies to accelerate the development of an electronic computer with the next generation	(8.61 billion yen)	(5.785 billion yen)
		2. Development Bank loan to the Japan Electronic Computer Co., Ltd.	(within 50 billion yen)	(within 48 billion yen)
		3. Development Bank loan for structural improvement	(within 50 billion yen)	(within 48 billion yen)
		4. Special redemption fund for high performance electronic information remote processing apparatus	-	-
	To promote software	1. Software production technological development plan	(1.52 billion yen)	(1.67 billion yen)
		2. Subsidies for operational expenses of The Council for the Promotion of Information Processing (includes above 10)	(2.58 billion yen)	(2.78 billion yen)
		3. Financial measure for information processing promotion (underwrite bank debenture)	(7 billion yen)	(5 billion yen)
		4. Development Bank loan to nurture technicians for software development and information processing	(within 50 billion yen)	(within 48 billion yen)
		5. Reserve fund system for general-use software development	-	-
		6. Reserve fund system for program guarantee	-	-
To promote the information industry To accelerate use of information	To advance systems development	1. Development of pattern information processing system (large-scale project of the Agency of Industrial Science and Technology)	(2.8 billion yen)	(1.846 billion yen)
		2. Development of a health care network system	(190 million yen)	(220 million yen)
		3. Development of a substitute energy type community energy system	(9 million yen)	(42 million yen)
		4. Development of a trade information system	(25 million yen)	(34 million yen)
		5. Development Bank loan to accelerate usage of information processing system	(within 50 billion yen)	(within 48 billion yen)
	Basic preparation to use of information	1. Survey on the actual state of information processing	(16 million yen)	(16 million yen)
		2. Survey on statistics of electronic computer orders fulfilled	(5 million yen)	(5 million yen)
		3. Survey on industries by classification converting to systems	(2 million yen)	(2 million yen)
		4. Survey on legal protection of software	(6 million yen)	(6 million yen)
		5. Program survey record	(2 million yen)	(2 million yen)
		6. Information processing technicians' exam	(62 million yen)	(68 million yen)
		7. Comprehensive survey on problems of information processing technicians	(2 million yen)	(2 million yen)

[Table 5 continued]

8. Safety measures for the information processing services	(0 million yen)	(2 million yen)
9. Safety measures for software, etc.	(700,000 yen)	(700,000 yen)
10. Loan system to accelerate safety measures for the electronic computer system (Development Bank) (medium and small financial institutions)	(within 50 billion yen for Development Bank) (3 billion yen for medium and small financial institutions)	(within 48 billion yen for Development Bank) (3 billion yen for medium and small financial institutions)
11. Register system for the information processing service business	(1 million yen)	(1 million yen)
12. Information changeover week	(400,000 yen)	(400,000 yen)
13. Subsidies to introduce electronic computers to Chambers of Commerce and others	(127 million yen)	(190 million yen)

The following activities are carried out to promote information processing:

(1) Commission development of highly advanced, general purpose programs which are difficult to be developed by private business.

(2) Sale of commission developed programs.

(3) Assume suretyship obligation for funds borrowed to sophisticate operations etc., from banking institutions by information processing businesses, etc.

(4) Conduct research on information processing and disseminate results.

(2) Promotion of Software Production Technology and Development Plan

Serve as a basis to develop a new system of automatic preparation with the editing and assembly of the program modules to replace program production by manual means as performed today and to establish the software industry as an independent industry with a modern production system.

This plan is a large scale project to extend for a period of 6 years, beginning in FY 1976, and will peak onprogram preparation in FY 1980. The sum of 1.672 billion yen is programmed for the development.

The development is being stepped up by commissioning the Association to Promote Information Processing Activities in place of the Joint Systems Development Co. (capitalized by 17 principal software business firms and 13 banks) which had been established in April 1976 to undertake said plan's development as its principal assignment.

(3) Security measures for the information processing services

Establish security measures with the electronic computer system of the information processing services to protect against any disruption of economic and social activities caused by such actions as data destruction from data leakage, fire, earthquake, etc., against any invasion of privacy, etc., and financing will be obtained from the Development Bank or any middle-small finance institution for any of the facilities. From FY 1980, enforcement of the security measures of the information processing services will be based on requests by the private interests, for registration and public release.

(4) Program reserve fund system

In order to establish software as a contractable item and to familiarize software as a marketable product, development of top grade software, especially general purpose software with high productivity must be accelerated. For this purpose, when general purpose software is developed and sold, the system will recognize 50 percent of the income, as the limit, to be deposits for the reserve fund.

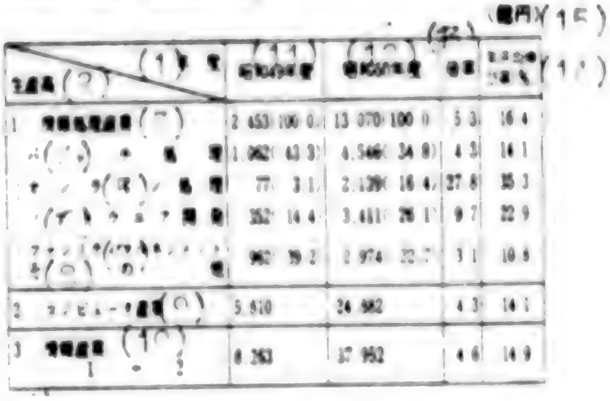
To retain the soundness of software business operations, based on the gratuitous repair contract of more than a year, attached to the independently prepared program, in case gratuitous repair is actually performed, then 0.25 percent (sic) of the sales on subject program will be acknowledged as a deposit for the reserve fund.

4. Future Outlook and Topics

According to the report "Japan's Information Status in FY 1985 and Forecast of the Growth of the Information Industry" prepared by the Information Industry Committee of the Industrial Structure Council in July 1976, sales of the information processing industry which had been 245.3 billion yen in FY 1974 will reach 1.307 trillion yen in FY 1985 or a growth percentage of 16.4 percent which will be higher than that of the computer industry. On the percentage of the information processing industry within the total information industry, it is interesting to note that the roughly 29 percent for FY 1974 will increase to about 34 percent in 1985. (Table 6)

Table 6. Forecasts on Sales of the Information Industry

Key:
- (1) Showa year designation
- (2) Total sales
- (3) Information processing industry
- (4) Batch processing
- (5) Online processing
- (6) Software development
- (7) Facilities management
- (8) Others
- (9) Computer industry
- (10) Information industry
- (11) FY 1974
- (12) FY 1985
- (13) Magnification (number of times)
- (14) Annual average increase percentage
- (15) Unit value=100 million yen



[illegible] (15)

[illegible] (1) / [illegible] (2)	[illegible] (11)	[illegible] (12)	[illegible] (13)	[illegible] (14)
1 [illegible] (3)	2,453 (100.0)	13,070 (100.0)	5.3	16.4
[illegible] (4)	1,062 (43.3)	4,546 (34.8)	4.3	14.1
[illegible] (5)	77 (3.1)	2,139 (16.4)	27.8	35.3
[illegible] (6)	352 (14.4)	3,411 (26.1)	9.7	22.9
[illegible] (7) [illegible] (8)	962 (39.2)	2,974 (22.7)	3.1	10.8
2 [illegible] (9)	5,910	24,882	4.3	14.1
3 [illegible] (10)	8,363	37,952	4.6	14.9

Based on the report "Numerical Forecasts on Japan's Information Conversion and Performance of the Information Industry During the Second Half of the 1980's and the First Half of the 1990's" by the Information Industry Committee of the Industrial Structure Council

(2) Topics

The information processing industry is a representative, knowledge-intensive industry, but since its history as an industry is short, its operational base as a business is weak. And because it is intangible, its value consciousness is weak which is a trait peculiar to the Japanese. Thus, of common interest are such activities as upgrading the information processing technology, training technicians to support this technology, strengthening the economic base relative to funds and establishing values on software, etc.

Comments on the individual services are as follows:

a. Software service: Upgrading software productivity, strengthening software development and accelerating software circulation must be effected; to accomplish this, software production technology, general practice technology, development of assessment technology and preparation of a circulation base must be accomplished.

b. Information processing service: Development of the technology on the effective use of the computer chamber, online technology, TSS technology, network technology, etc., and storage must be promoted. Plan to strengthen the security measures of the electronic computer system, beginning with data protection. The smooth execution of social responsibility will be required.

(c) Information furnishing service: Development of data conversion maintenance, data management, online retrieval, etc., as well as mass data storage processing multi-use possibility of the information furnishing service must be effected.

(3) Hope of the information processing industry

The information processing industry will have an enormous market, if the latent demand is included, and a bright future; its prospects as an industry with high employment potential is good; and depending on whether the information processing industry furnishes service of acceptable standards, the upgrading of the national livelihood and the international competitiveness of the other industries will be influenced. For this reason, it is strongly hoped that Japan's information processing industry will wipe out the gap existing between the advanced countries of Europe and the United States, and effect a smooth growth.

Optical Industry

Tokyo KOGYO GIJUTSU in Japanese Vol 21, No 6 Jun 80 pp 52-55

[Article by the Electronic Equipment and Electrical Machinery Section, Machinery and Information Industries Bureau, MITI]

[Text] 1. Special Features of the Optical Industry Technology

The optical industry technology is a technology that uses light or electromagnetic waves with a frequency several digits higher than that used in electronics technology for information transmission, information processing, instrumentation control, etc. (Figure 1)

This technology consists of laser, light receiving element, light fiber, etc., and it has the following special properties:

(1) High speed, wide-range transmission and processing possible. (Far beyond comparison with electronics used heretofore, and it is possible to transmit the process large volumes of information at high speed.)

(2) High speed transmission and processing of image information possible

(3) Lightweight optical fiber for transmission line use.

(4) Optical element can be used as an infinitesimally small size circuit element like in VLSI.

(5) Use of copper wire is not necessary, contributing to resource conservation.

(6) Electromagnetic noise interference eliminated.

(7) Serves as an electrical insulator.

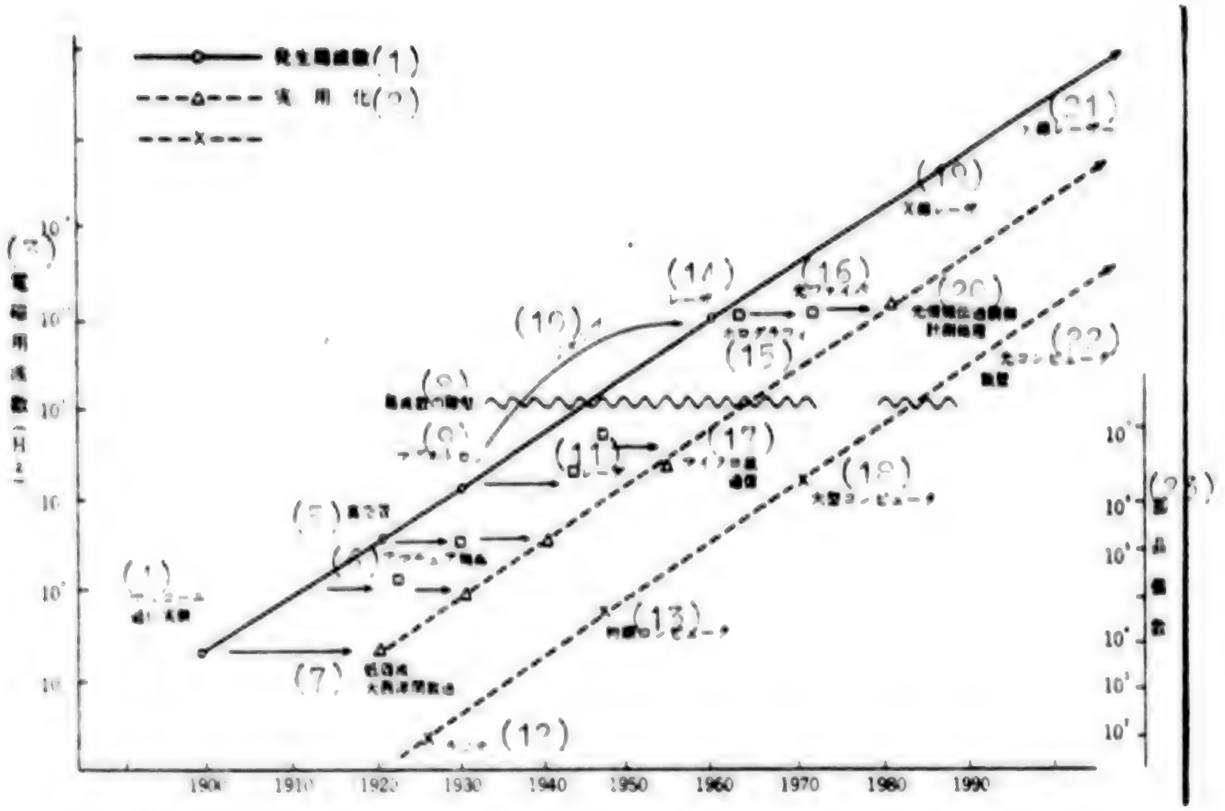


Figure 1. Outline of the Optical Industry Technology

Key:
(1) Generated frequency
(2) Practical application
(3) Electromagnetic wave frequency
(4) Marconi's communication experiment
(5) Vacuum tube
(6) Amateur wireless
(7) Low frequency; broadcast across the Atlantic Ocean
(8) Frequency barrier
(9) Magnetron
(10) Jump
(11) Radar
(12) Radio
(13) Early phase computer
(14) Laser
(15) Holography
(16) Optical fiber
(17) Microwave communication
(18) Large-size computer
(19) X-ray laser
(20) Optical information transmission control; measurement processing
(21) Gamma ray laser
(22) Optical computer; (numbers barrier?)
(23) Component count

(8) Optical fiber and other materials are fireproof, waterproof and rustproof.

2. Development Stages of the Optical Industry Technology

Optics was utilized for communication as far back as prehistory, and the history of optical science, as exemplified by the microscope which uses the lens technology, is long, but it was the successful laser emission in 1960 by Meiman that heralded the era of optoelectronics and as today's technological innovation, its history is only 20 years old. (Tables 1 and 2)

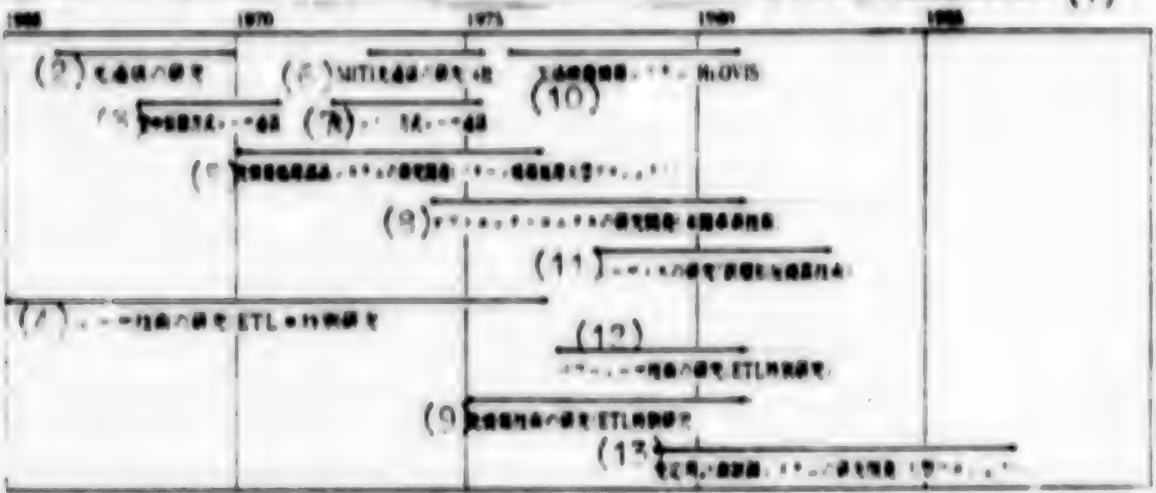
Table 1. Development Stages of Optical Technology of the World

	1950's	1960's	1970's	1980's
	Theory of laser announced (1951)	Ruby laser oscillations (1960)	Gallium aluminum arsenide (semiconductor) laser, continuous oscillations at room temperature (1970)	
	Semiconductor laser theory (1958)	Helium-neon laser oscillations (1961)	Gallium Indium Arsenide Phosphorus laser oscillations (1976)	
	Glass fiber for medical use discovered (1951)	Gallium arsenide (semiconductor) laser oscillations (1962)	Semiconductor laser with longevity performance (1977)	
		YAG laser oscillations (1964) Carbon dioxide laser oscillations (1964) Graded type fiber submitted (1964)	Low loss glass fiber developed (1970)	
	Optoelectronics proposed (1955)	Glass fiber with low loss proposed (1966)	Pure quartz core fiber developed (1972)	Laser functions Fiber functions
	Holography developed (1950)	Graded type fiber developed (1969)	Extremely low loss optical fiber developed (1976) New method for continuous manufacturing of optical fiber invented; (VAD method) (1977)	Hologram functions
	Space filtering developed (1953)	Optical integrated circuit (Optical IC) proposed (1969) Luminous flux holograph developed (1962)	(chu) infrared region fiber developed (1978) Wave-type optical forking circuit developed (1973) Wave path hologram developed (1976) Autobonding semiconductor laser (1975)	All optical integrated circuit Picosecond optical technology
Optical information technology	Information collection (Optical measurement)	Laser radar (1962) Measuring with holography interference (1965) Laser spectrometry (1968)	Pollution sensing laser (1970)	Space optical measuring system Oceanic optical measuring system Energy measuring system

[Table 2 continued]

Optical information technology	Information transmission (Optical communication)	Laser communication with atmospheric propagation (1965)	Optical fiber communication (1970) Optical fiber reflex communication (1974) Home reflex information system (1976) Public communication system with optical fiber (1978)	Space optical communication system Oceanic optical communication system Energy information system
	Information processing	Holography pattern recognition (1964) Optical disk memory (1965) Holography memory (1967)	Laser facsimile (1973) Laser POS (1975) Laser video disk (1975)	Optical computer Three dimensional display Large capacity optical disk file
Optical energy technology	Optical processing	Laser (scriber?) (1963) Laser drill (1965)	Laser welding (1975)	Laser bombardment
	Laser with large output utilized	Laser plasma generation (1968)	Uranium concentrates with laser (1975) Laser annealing (1976)	Nuclear fusion with laser Isotope separation
	Optical energy transmitted	Laser (mes) (1965)	Energy transmission with optical fiber (1974)	All optical telephone Oceanic ranch

Table 2. Progress on Optical Technology Undertaken by MITI



Key: (1) Electrotechnical Laboratory (ETL)
(2) Research on optical communication
(3) Space propagation type laser communication
(4) Research on laser technology; special research at ETL
(5) Research and development on optical information processing component system (large scale project on pattern information processing)
(6) Research on MITI's optical communication (four companies)
(7) Laser communication by optical fiber method
(8) Research and development on optoelectronics (hitherto unexplored innovative technology)
(9) Research on optical information technology (special research at ETL)
(10) Home reflex information system
(11) Research on laser (mes) (technology for medical and welfare equipment)
(12) Research on power laser technology (special research at ETL)
(13) Research and development on a measurement control system for optical applications (large-scale project)

The following is an outline of its development stages:

a. 1960's: Basic research on coherent laser.

b. 1970's: Semiconductor laser and optical fiber technology established.

c. 1980's: Practical application of optical communication; research on optical IC, etc.; trial manufacture of prototypes. The 1980's will finally be the period when optical information technology will move from the test chamber level to practical application.

Japan initiated research around 1961, soon after Meiman's success. A research chamber was established in the Electrotechnical Laboratory of the Agency of Industrial Science and Technology in 1965 to pioneer Japan's research in the discipline and it played a big role in such activities as trial manufacturing Japan's first optical and communications fiber unit of the ETLOF series. Thereafter, the Nippon Telegraph and Telephone Public Corporation began full scale research and development on communications application of the optical industry technology from 1973, and research was stepped up in conjunction with research units of private companies, universities, etc.

The basic studies for research and development on optical industry technology were U.S. oriented but recently remarkable achievements in the field of optical fiber, etc., have been made in Japan.

3. Outlook, Policies and Direction of the Optical Industry Technology

The optical industry technology, which had gone through the above described development stages, will be gradually introducing the applied field (Figure 2), and it is predicted that, after fulfilling the phases described below, they will be the mainstays in the information field (including a part of energy transmission) during the years 1985 to 2000. These can be generally described in three phases:

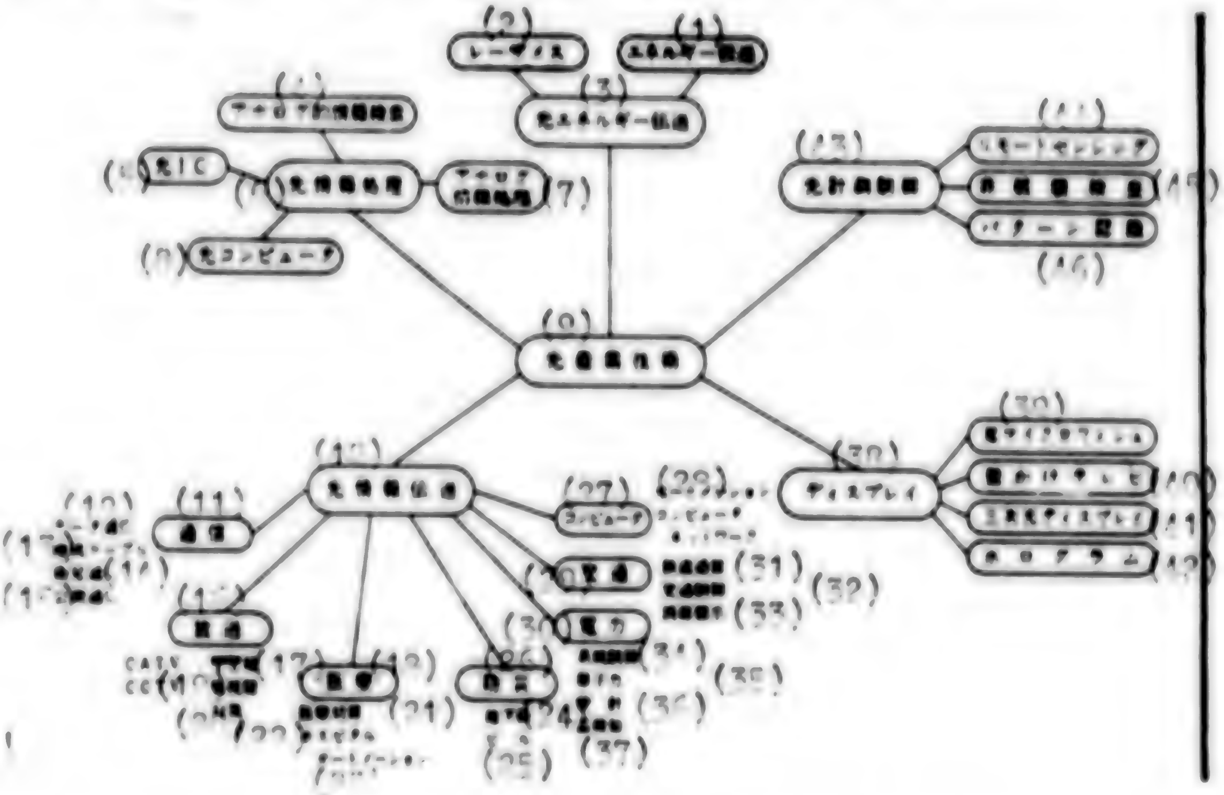


Figure 2. Fields of Application in the Optical Industry Technology

Key:
(1) Energy transmission
(2) Laser (mes)
(3) Optical energy transmission
(4) Analog information retrieval
(5) Optical integrated circuit
(6) Optical information processing
(7) Analog information processing
(8) Optical computer
(9) Optical industry technology
(10) Optical information transmission
(11) Communications
(12) Data communication
(13) Oceanbed cable
(14) Satellite communication
(15) Public communication
(16) Broadcasting
(17) Post office
(18) Medical treatment
(19) Visual-aural difficulty
(20) Measures
(21) Medical information
(22) Hospitals
(23) Automation
(24) Underground passageway
(25) Buildings
(26) Prevention of disasters
(27) Computers
(28) Automation computer network

[Key to Figure 2, continued]

(29) Transportation
(30) Electric power
(31) Railway communication
(32) Traffic control
(33) Inductive indicator
(34) Systems control
(35) Atomic energy
(36) Meter inspection
(37) Lightning detector
(38) Display
(39) Priming microfiche
(40) Wall mV
(41) Three dimensional display
(42) Hologram
(43) Optometry control
(44) Remote sensing
(45) Non-destructive exam
(46) Pattern recognition

Phase I. Use of optical fiber in place of copper wire, used heretofore, as the transmission line which is a part of the existing electronics system (evidence of this switchover already seen today.)

Phase II. Use of the optical functional element for signal processing, beginning from both ends of the optical fiber; functions of the optical switch, optical branch, optical (bunpa), optical modulation, optical sensor, etc., will be upgraded.

Phase III. The optical industry technology will become the core of the system technology and the entire system will be integrated with this technology.

A study is required on the transition of these stages, but it is felt that in Phase I a part of practical application had started in the latter half of the 1970's and an item with optical function will be developed beyond expectation in the 1980's; Phase II will take place between the mid-1980's to mid-1990's; Phase III will start from the late 1980's to full scale conversion in the mid-1990's.

Until recently, the optical industry technology in the various countries was limited to the research lab level, but focusing on communications application, they began to exert efforts with research and development on the optical industry technology that could penetrate the limits of technology used heretofore.

In order for Japan to gain a firm position in the electronics industry and subsequently the optical industry, it must by all means develop the optical industry as an entirely new type of industry. The requirements are:

(1) Technological development

(2) Apply results of the technological development in society

(3) Measures to integrate the surveys on the optical industry technology and optical industry, and future plans must be made.

From the standpoint of needs, the accomplishments from technological development will be (1) (image) information transmission, (2) (image) information file, (3) instrumentation control and (4) computers; from the standpoint of (shizu), the accomplishments will be (1) optical IC technology, (2) optical transmission line technology, (3) optical sensor technology and (4) optical actuator technology. To conduct research and development on these subjects, the governmental experimental and research agencies, and private company research units must conduct assignments to suit the character of their individual organization, and whose research themes can be fulfilled.

Presently the Agency for Industrial Science and Technology is engaged in the development of a large scale project on the optical applied instrumentation control system, but on optical IC technology and related subjects which would be the nucleus, from the long range viewpoint the exploratory basic research would be conducted at the Electrotechnical Laboratory and other agencies, and the actual applied research would be conducted by private companies, and in order to coordinate these comprehensive developments, the projects must proceed with the promotion of an efficient, intensive research.

As to the results of technological development applied in society, studies of the practical applications, demonstration tests and similar tests must be made on the applications in the various social systems and industrial systems of the various high level technologies derived from the above technological developments.

Growth and expansion are strongly expected of the optical industry which, along with the computer and atomic power industries, will be taking a central role in Japan's industrial structure. And especially since the optical industry technology is in the germinating stage of a technology, Japan has the capability of taking the initiative before the rest of the world to develop this discipline. The thought of becoming the world's frontrunner in this type of industry may be the first to be attempted, but it should be one of the challenges Japan should face going into the 21st century.

Engineering Industry

Tokyo KOGYO GIJUTSU in Japanese Vol 21, No 6 Jun 80 pp 56-61

[Article by the Industrial Machinery Section, Machinery and Information Industries Bureau, MITI]

[Text] 1. Development Stages of the Engineering Industry

Japan's engineering industry was pioneered by chemical engineering with the resumption of petroleum refining during 1950-1954, and with the backing of investments from flourishing institutions, private companies in the varied fields of industry such as machinery, electrical equipment, iron and steel, chemical textiles and construction became suppliers and makers of industrial equipment, and as users they accumulated high level knowledge on engineering.

With the increasing demand for such activities as plant export and pollution prevention, and the expansion of various enterprises and the effective utilization of manpower, etc. based on accumulated engineering knowledge, positive development of business enterprises furnishing engineering services or new business enterprises had been evident from 1965 on. Recently this intensity of expanding operations has been noted with the engineering aspects of the iron and steel, shipbuilding, heavy machinery, and the building and construction industries.

A review of the number of engineering companies or companies that include engineering operations shows a rapid increase from a mere collection of 10 companies in 1955 to about 70 companies in 1965, and today there are more than 300 companies.

In this manner, the engineering industry has gained its place, a new industry that has grown and one that is expected to be a pillar to support Japan's economic growth in the next generation.

2. The Present State and Problems of the Engineering Industry

Although the development of Japan's engineering industry has been remarkable, it is still in the developing stage and a wide gap still exists in technology and business operations with the leading nations of Europe and the United States. In the conditions that would serve as basis for growth hereafter, many of the problems given below are included:

(1) Regarding Japan's engineering industry whose growth had been supported by private investment institutions and plant exports, even to this day, 70 to 80 percent of its sales was derived from production equipment for chemical plants, power plants, iron and steel plants, etc. Japan has limited experience and lacks engineering knowledge to meet the rise in new social needs hereafter and to actively exploit such fields in public welfare as medical, urban development, education, transportation at home and abroad.

(2) Even with resources and energy whose importance will increase greatly hereafter and with production facilities, the software technology which is the key to engineering of the processing know-how has continued to be imported from abroad, the scope of Japan's engineering capability has been limited and its base is shallow.

(3) On the basic engineering techniques such as process management, cost management and document management which play important roles in the accomplishment of large scale projects, Japan is still immature when compared with European nations and the United States, and even its current practices cannot be considered fully adequate.

(4) As to key personnel who are basic requisites in determining engineering capability, the problem of quantity and quality has surfaced. Of deep concern is the lack of project managers who can oversee and manage the entire project. As to number of people who can supervise large projects, Japan has less than 200, but for those who can manage large, international-scale projects, Japan has less than 100. Problems exist not only in nurturing these key personnel but also in revising the educational system, the employment system, etc.

(5) Partly because of its short history, assessment standards on engineering activities have not been adequately established and the prevailing practice is still to consider such service as gratis. Especially during that stage of consulting and related work before designing, nothing has been established on payment for services. Added to this situation is the fact that on taxes and finances, the engineering business is backward and the business operation which supports the engineering industry is still weak.

In order to conduct engineering activities which is dependent on the type of project engaged in, it is important that the engineering personnel of the different companies or the engineering firm and equipment manufacturers or others must meet in various ways to cooperate and collaborate, and to concentrate their individual capabilities and functions. But the engineering business itself has a short history and because it is an offshoot from various industries, it is difficult to promote cooperation and collaboration because the order of the business world structure is extremely backward. The lack of publications on engineering terminologies, contracts and other documents, the standardization and normalization of hardware and software of related equipment, lack of information that would be of common use with other industries, a study of laws and regulations related to engineering, etc., are matters which indicate the inadequacy of the foundation of the engineering industry.

3. Promotional Policies of the Engineering Industry

(1) Strengthening engineering technology

It is conjectured that the activities of the engineering industry in the 1980's will make a large turn from activities related to production facilities as in the past to those related to resources and energy as well as on public welfare. In line with this, the engineering industry must place outstanding key personnel in the fields of resources, energy and public welfare with a long range viewpoint and it must exert positive efforts in the engineering requirements of these fields.

On the above viewpoint, the following measures must be taken:

(1) Conduct feasibility studies and other studies on resources and energy related projects. (Figure 1)

Relative to resources and energy, large projects on petroleum storage, coal liquefaction, nuclear power generation, geothermal heat generation, etc., are about to be executed, but the engineering industry must conduct feasibility studies on these projects in order to exert its engineering capabilities.

As to the engineering phase of research and development that must be made on underground petroleum storage, coal liquefaction, use of hot drainage water from nuclear power generation, geothermal power generation, geothermal hot water use, etc., the decision to strengthen the engineering capability must be made only after conducting joint research with the related businesses.

(2) Development and practical application of the public welfare type systems. (Figure 2)

In order to determine the development and practical application of the public welfare type systems, the following measures must be positively enforced:

(a) Promote a joint development agreement for the public welfare types systems. In order to respond to the social needs of the national and local autonomous agencies, a joint development agreement must be actively promoted for a public welfare type system of a high community level.

(b) Promote the construction of a showplace for the public welfare system. Promote the construction of a showplace for demonstrations of the researched and trial manufactured public welfare type system in order to obtain the reaction of the general public.

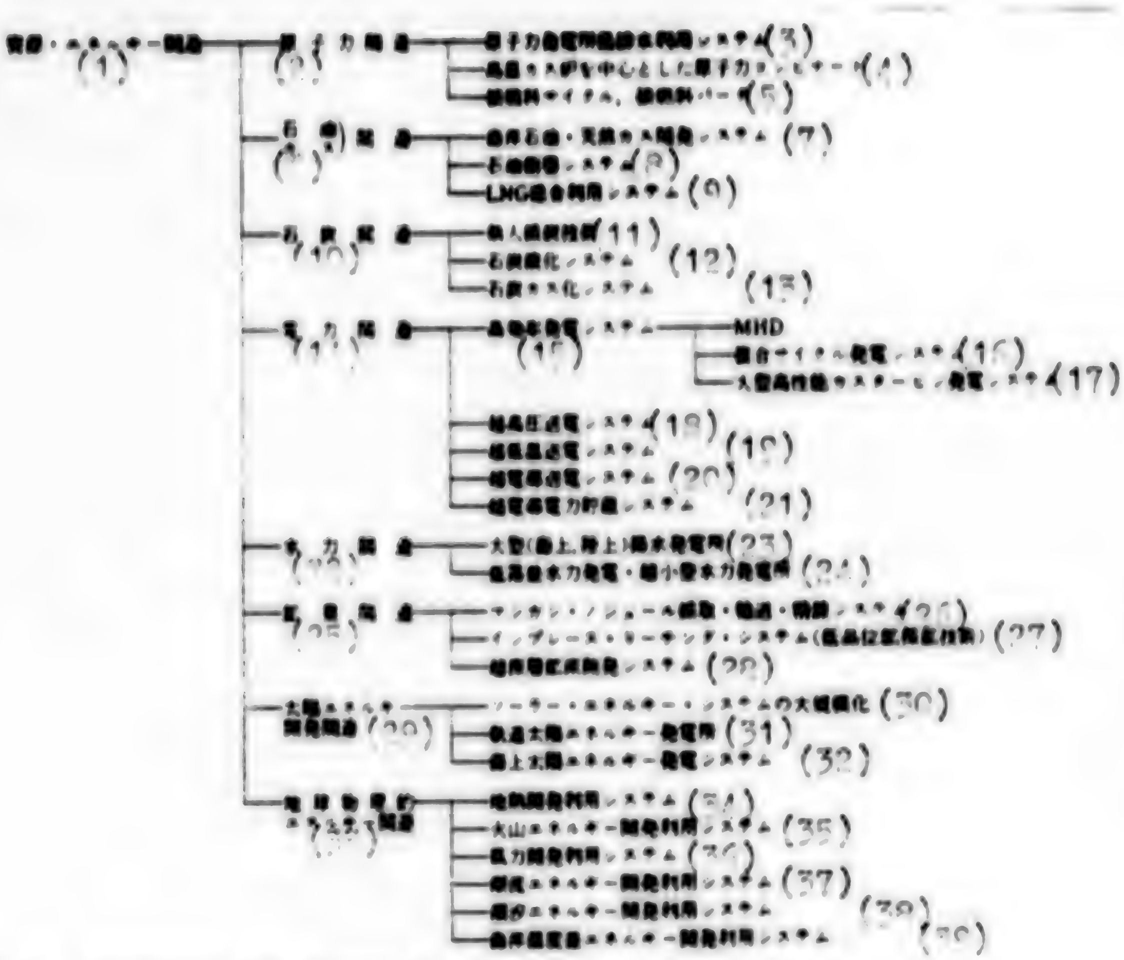


Figure 1. Resource and Energy Related Projects

Key:
(1) Resource and energy related
(2) Nuclear power related
(3) A system to utilize hot drainage water from a nuclear power plant
(4) Nuclear power complex built around high temperature gas reactors
(5) Nuclear fuel cycle and nuclear fuel park
(6) Petroleum gas related
(7) Oceanic petroleum and natural gas development system
(8) Petroleum emergency storage system
(9) LNG comprehensive use system
(10) Coal related
(11) Unattended coal mining technology
(12) Coal liquefaction system
(13) Coal gasification system
(14) Electric power related
(15) High efficiency electric power system
(16) Compound cycle power generation system
(17) Large-scale, high performance gas turbine power generation system
(18) Extra high voltage power transmission system
(19) Extra low temperature power transmission system
(20) Superconduction power transmission system

[Key coutinued]

[Key continued from previous page]

(21) Superconduction electric power storage system
(22) Water power related
(23) Large scale pumped water power plant (on sea and on land)
(24) Low head hydroelectric power plant and extra small type hydroelectric power plant
(25) Mining related
(26) Manganese nodule collecting, transporting and refining system
(27) (Impress reaching?) system (low grade ore mining technology)
(28) Extra deep ore bed stratum development system
(29) Solar energy development related
(30) Solar energy system on a massive scale
(31) Orbiting solar energy power station
(32) Maritime solar energy power station
(33) Geophysical energy related
(34) Geothermal development and use system
(35) Volcanic energy development and use system
(36) Wind velocity development and use system
(37) Tidal energy development and use system
(38) Oceanic tide energy development and use system
(39) Oceanic temperature differential energy development and use system

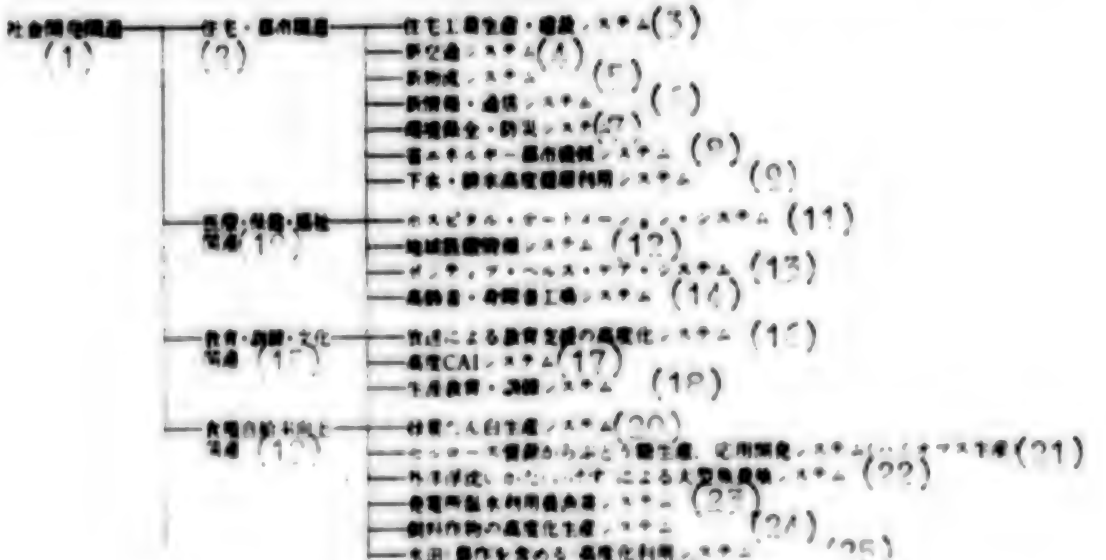


Figure 2. Development and Practical Application of Public Welfare Systems
[Key on following page]

[Key to Figure 2 on preceding page]

(1) Public welfare related
(2) Housing and urban related
(3) Production and construction system of the housing industry
(4) New transportation system
(5) New commodity flow system
(6) New information and communication system
(7) Environmental protection and disaster prevention system
(8) System to conserve energy with urban area machinery
(9) System to use sewage and drainage water through advanced cycling
(10) Medical, hygienics and welfare related
(11) Hospital automation system
(12) Regional medical information system
(13) Positive health care system
(14) A factory system for the aged and handicapped
(15) Education, training and culture related
(16) An advanced system for educational support through broadcasts
(17) Advanced CAT system
(18) Lifetime education and training system
(19) Related to the elevation of the food self-sufficiency rate
(20) System to produce protein from green leaves
(21) System to apply and develop dextrose production from cellulose material (biomass production)
(22) System to cultivate large size fish with floating rafts in the open sea (floating cage fish preserve)
(23) System to utilize hot water from power plants for agriculture and fishing
(24) Highly advanced production system for feed and farm produce
(25) Highly advanced system on use of the rice paddies (includes the second crop)
(26) System to convert animal excretion into fertilizer
(27) Food storage and distribution system
(28) (Chijo) industrial type food processing and distribution complex
(29) System on suitability and advanced development on new environment for industries
(30) Changes for resource conservation and saving energy
(31) Raw material switchover
(32) Manufacturing method switchover
(33) Energy switchover
(34) Design concept switchover
(35) Accommodation for a society for the aged
(36) Advanced robot system
(37) Advance the level of the black box system
(38) Accommodation for needs diversification
(39) Advance the level of the computer aided design system
(40) Advance the level of the system to produce many products in small quantities
(41) Advance the level of the automated assembly system
(42) Convert medium and high grade materials to CAM

(c) Promote the investments to users of the public welfare type systems.

(3) Strengthening the international type engineering capability. To strengthen the international type engineering capability, basically means gaining engineering

capability through the development of domestic projects on resources, energy and public welfare type systems and then undertaking international projects; however, executing the following measures along with the above will be effective:

(a) Promote engineering for economic cooperation. Furnish subsidies or commissions for engineering expenses, testing and research expenses, etc., which are necessary to develop improved tests and new techniques on the existing technology and for economic cooperation and technological cooperation suited to the needs of the serviced country.

(b) Promote international joint research agreements for public welfare type systems. Promote agreements that would contribute to the social development of Japan, the serviced country and other developing nations through joint development and practical application internationally of public welfare type systems which are applications of the latest space, aeronautical and communications technologies possessed by the advanced countries.

(2) Nurturing key personnel. Considered to be an intelligence-intensive and a knowledge-intensive industry, the engineering industry is one that considers key personnel as operational resources. Therefore, an essential subject is the nurturing of outstanding key personnel with ample experience and knowledge, excellent capabilities to perform operations and with a flair for international concepts. Key personnel, who are versed in all aspects of a project manager and a systems engineer and who can respond quickly to upgrading of projects to a larger scale, of international involvement, to increases in interdisciplinary public welfare type projects which is the trend recently, must be cultivated.

At present, training courses are offered at the Engineering Promotion Association to cultivate key personnel, but to achieve greater results, a study must be made to establish a training center that would offer training specifically for technicians engaged in engineering.

Besides considering the introduction of courses on the tax system as part of the education within the business firm, efforts must be made to supplement the engineering courses offered at the universities.

(3) Promote standardization of engineering. Considerable progress has been made in the standardization and normalization of hardware, but hereafter standardization of software especially must be undertaken, i.e. standardization of contracts, management documents, engineering terminologies, map indicators and symbols, etc. The Engineering Promotion Association has begun this task.

(4) Establish an appraisal standard for engineering. In order to establish a practice of a separate payment for hardware which is the engineering fee, a standard method of computing an engineering fee must be drawn up (the Engineering Promotion Association has already begun the task), an accounting method must be established and efforts must be exerted to spread the separate order system of engineering expenses in the event of a project involving the government and private business.

4. Future Outlook of the Engineering Industry

(1) Outlook on engineering demands

(1) Such prerequisites as the extent of growth of world trade, the extent of improvement in foreign currency holdings by developing nations and the balance of supply and demand of resources and energy for the 1980's are uncertain, the projects related to resources, energy, public welfare and urban development will turn big scale and more complex, and the engineering demands can be expected to steadily form an increased base.

(2) As for domestic engineering demands during the 1980's,

i) engineering enterprises related to energy are expected to increase sharply.

(a) Investments on petroleum storage will increase because further unstableness of the petroleum supply and demand balance in the 1980's is forecast.

(b) As energy sources to augment the shortage of petroleum supplies, investments on liquefied gas accompanying the increased use of LPG and LNG, investments on research and development on gasification and liquefaction technologies with coal (foreign coal included) and their practical application, investments on research and development on the technology to use heavy oil such as high (metaru) and high sulphur and their practical applications will increase.

(c) An increase in investments to develop oceanic petroleum from Japan's environs and coastal waters, and an increase in investments on research and development of seabed petroleum production system and its practical applications are predicted.

(d) Investments on nuclear power generation accompanying an increase in electric power demand, and on uranium concentrates, disposal system for radioactive waste materials, etc., will increase.

(e) Investments on sectional energy systems such as geothermal power generation, medium and small size thermal power, hydroelectric power plants, etc., will increase.

(f) Investments on large scale power transmission systems will increase because of stringent power demands and increasingly heavy unbalance in the supply and demand between sections are predicted.

ii) An increase in engineering projects related to public funds is expected.

(a) As for national land development and use, an increase in engineering projects is predicted because of the expected execution of large scale projects on building and construction of multi-purpose dam utilization systems, harbors, airports, highways, railways, etc.

(b) Investments on research and development and practical application of such public welfare type systems as environmental protection systems, water supply and drainage systems, medical welfare systems, transportation, commodities distribution system, information communication system, educational system, housing, urban systems, etc., which are for the maintenance and elevation of public welfare are predicted.

iii) The engineering activities related to processing plants for industrial raw materials production such as the petrochemical and steel manufacturing plants are expected to be reduced.

(a) Factors to be considered are that the above mentioned engineering activities have already reached a definite supply capacity, the availability of locations and space for any large scale complex is limited, new demands as obtained heretofore cannot be expected and the demand for pollution prevention plants that made a tremendous stride in the 1970's have already rounded their courses.

(b) It is considered that in the 1980's, rather than the new installation of facilities, the emphasis will be on the renovation or changing demand of existing plant facilities directed at saving energy and conserving resources.

(c) An increase in machinery and equipment production plants is expected, but at the present stage this phase is considered to be, not a part of the engineering industry, but that of equipment manufacturing.

iv) With the above factors considered, the domestic demand of the engineering industry in the 1980's will maintain the theme of expansion and growth, but it can be said that the tempo of expansion and growth cannot be expected to exceed that of the 1970's.

([illegible]) Engineering demands abroad for the 1980's are:

i) Further increases in investments in production plants for oil producing countries and in national urban development are expected.

ii) An increase in investments on plants for resource development in resource possessing nations is expected.

iii) Seeking new markets in China, Africa and other countries is expected.

iv) Since developing nations strongly desire to be self sufficient with industrial raw materials, demands for medium and small size plants suited to meet their industrial needs can be expected.

v) Increase in investments for agricultural development, medical welfare systems, water supply and drainage systems for developing nations can be expected.

On the other hand:

i) A constantly favorable foreign exchange market or foreign currency situation in the different nations cannot be expected.

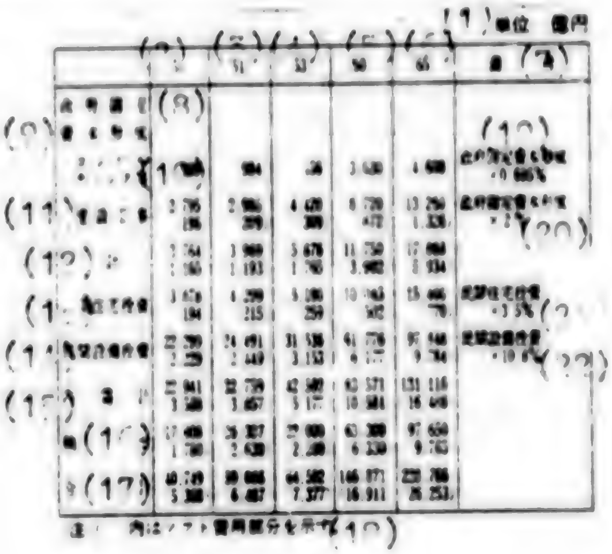
ii) The continuing political instability of developing nations during the 1980's is a possibility.

iii) As to the new markets in China and other nations, many restrictions exist on the conditions for payment on a plant order, and there are many unclear points on expansion of the market size.

iv) Uncertain factors, such as the possibility of the competition with the engineering businesses of Europe and the United States becoming intensified, must be considered.

However, despite these considerations, it is felt that the overseas engineering demands during the 1980's will continue to expand to a highly developed standard.

Table 1. Future Outlook on Japan's Engineering Industry



Key: (1) Unit value=100 million yen
(2) 50=1975
(3) 51=1976
(4) 53=1978
(5) 60=1985
(6) 65=1990
(7) Remarks
(8) (9) Government's fixed capital formation
(10) consulting, etc.
(11) Building and construction
(12) Total
(13) Investments on private homes
(14) Investments on private facilities
(15) Domestic requirements
(16) Exports
(17) Total
(18) Note: Figures in parentheses indicate software costs
(19) Government's fixed capital formation x 0.695%
(20) Government's fixed capital formation x 2%
(21) Investments on private homes x 3.5%
(22) Investment on private facilities x 10.8%

(Reference)

Using the forecasts from the government's fixed capital formation, etc., as basis, the trial balance of the scope of sales for the engineering industry shows that in 1978 the total sales, including procurement of machinery and equipment, construction, etc., was about 6.46 trillion yen of which the engineering portion or the software amount was 740 billion yen. (Table 1) Note that the upper figures indicate the total costs incurred beginning with basic designing, detailed designing, procurement of machinery and equipment to building and construction, and the figures in parentheses refer to software costs.

In 1985 the total sales is forecast to be 14.7 trillion yen and software, 1.7 trillion yen, and in 1990 the total sales is forecast to be 22.9 trillion yen and software 2.6 trillion yen.

Robot Industry

Tokyo KOGYO GIJUTSU in Japanese Vol 21, No 6 Jun 80 pp 62-67

[Article by the Industrial Machinery Section, Machinery and Information Industries Bureau, MITI]

[Text] 1. Definition of Industrial Robot

The industrial robot possesses functions that can execute diverse movements in a 3-dimensional space and today it is defined as "a machine that can execute extremely free moving functions which resemble those of man's upper limbs (arms and hands) and that can act autonomously with sensual and perceptive functions."

The industrial robot is used primarily in the production process to control the arbitrary movements of objects, but it can also be equipped with tools to perform direct operations such as welding, painting and machinery processing. It can be automated for diversified small quantity production automation of which was difficult heretofore, and it has contributed to upgrading productivity, product quality and efficiency of facilities.

It has performed many roles in contributing to labor welfare and it has prevented labor disasters and occupational sicknesses from occurring by engaging in operations dangerous or rigorous to human beings or being under adverse environmental conditions because automation was difficult.

Hereafter, with technological improvements, the industrial robot will not only assume the motor functions of man's upper limbs, but also those of the lower limbs and those of such animals as the snake and crab.

The industrial robot can be classified into three kinds: the manual information and instructional, the sequential informational and the moving forms. (Tables 1, 2 and 3)

Types	Definition	Equivalent English
Manual manipulator	Man-operated manipulator	
Fixed sequence robot	Manipulator advances successively with each stage of movement in sequence, condition and locations which are fixed in advance; changes in fixed information cannot be made easily.	
Variable sequence robot	Manipulator advances successively with each stage of movement in sequence, condition and locations which are fixed in advance; changes in fixed information can be made easily.	
Playback robot	Man-operated and is fed instructions on sequence, locations and other information which, depending on the necessity, is recalled and followed by robot to complete assignment.	

[Table continued]

Types	Definition	English Equivalent
Numerical controlled robot	Manipulator performs assignment by following numerical instructions on sequence, locations and other information; e.g., perforating paper tape cards and using the digital switch,	
Intelligent robot	Robot determines actions through sensory or recognition functions.	

Note: The manipulator has functions similar to those of man's upper limbs (arms and hands) and can move assigned items through space.

Table 1. Types of Manual Information and Instructional Robot

Types	Definition	English Equivalent
Single purpose robot	Mechanism of manipulator has a fixed memory function. Remark: Cannot be converted to repeatable robot because of control device.	
Repeatable robot	Manipulator can repeat operations in accordance with work program stored in advance.	
Single programmed repeatable robot	The fixed program and work cycle program cannot be changed easily; e.g., programmed by cam and relay circuit.	
	* Variable program 1: Work cycle program can be easily changed and the control advances with the fixed sequence according to program; e.g., pin board and tape cards.	
	* Variable program 2: Program can be changed easily and during the cycle, per condition, it has the function to branch out. Note: general type sequence. Remark: Some of the robots with asterisks* have adaptable functions added on (functions to modify locations and sequence information).	
Multi programmed repeatable robot	It has several work cycles and can select cycle programs through the instructions program; e.g., minicomputer and general use sequence.	
Intelligent robot	Robot determines actions through sensory or recognition functions.	

Table 2. Types of Sequential Informational Robots

Types	Definition	English Equivalent
Cylindrical coordinates robot	Manipulator whose movements are primarily of the cylindrical coordinate form.	
Polar coordinates robot	Manipulator whose movements are primarily of the polar coordinate form.	
Caresian coordinates robot	Manipulator whose movements are primarily of the caresian coordinate form.	
Articulated robot	Manipulator whose movements are primarily in articulated arrangement.	

Table 3. Types of Moving Form Robots

2. History of Industrial Robot Development

The word robot was derived from a character in the play "Rossum's Universal Robot Manufacturing Co. RUR," written in 1920 by the Czechoslovakian playwright Karel Capek who was a fighting freedom-loving intellectual. Said character [robotit in Czech means to drudge] was a mechanical man.

The phrase "industrial robot" was first used in America by the newspaper American Metal Market in 1960, and the concept of the industrial robot was reportedly announced in America in 1954 by Geroge [sic] C. Devol in his patent application "Program Article Transfer" which expressed the concept of the playback robot, mentioned above in robot classifications.

Based on this patent, the Consolidated Control Corp. of America in 1958 announced its prototype which is considered to be the pioneer of industrial robot development.

The first Unimate and the (Bastoran), today referred to like synonyms for the industrial robot, were produced in 1962.

The first European industrial robot was made by the Kaufelt Co. of Sweden around 1963 when it announced that its first operational unit could compose programs.

In Japan the fixed sequence type industrial robot was already developed in the early 1960's; independent development and domestic manufacturing with introduction of foreign technology of the playback robot was begun in 1968; and the line-up of the principal industrial robot makers of Japan today was established by 1971.

Japan has about 140 industrial robot companies as compared to about 40 companies in Europe and the United States, and from the standpoint of numbers, state of research and development, and spread of industrial robot use, Japan has taken the world's leading role in the field of industrial robots.

3. Movements of the Industry

(1) Movements in production

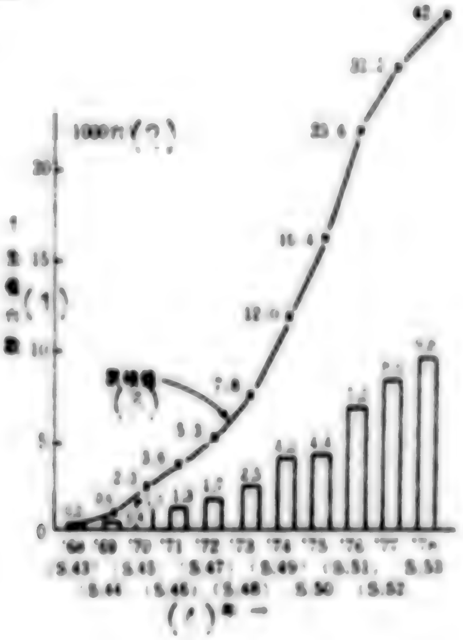
The playback robot was imported from the United States in 1967 and with the strong impetus received from this, Japan stepped up research and development to import industrial robots. Because of the drop in the economy and from problems with application technology in 1971, its production was at a standstill, but a turn for a quick upward swing took place in 1973. However, with the stagnation in capitalization of facilities caused by the economic recession from the oil shock in October 1973, the anticipated fast growth of industrial robot production never occurred.

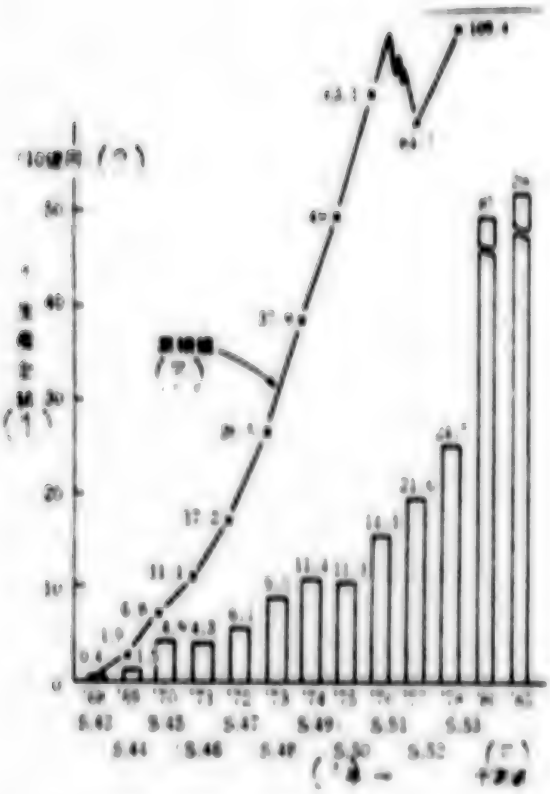
The succeeding decline in economic growth caused a reduction in plans to invest in new facilities for increased production, but with the increase in investments to save power and to automate for upgrading productivity to cope against increased cost of living and higher wages, industrial robot production increased steadily in 1976. And although production increased steadily in this manner, the annual production in 1978 was 24.7 billion yen and this signified the first step in attaining the era of practical application. (Figures 1, 2 and 3)

Hereafter, the industrial robot production is forecast to rise sharply to fulfill the strong demands of upgrading productivity and labor safety for the industrial world, and the annual production amount for 1985 is forecast to be 290 billion yen according to the demand forecast made by the Japan Industrial Robot Industry Association and the Nomura Research Institute of Technology and Economics.

Figure 1. Annual Figures on Industrial Robots Produced

Key:
- (1) Number of units produced
- (2) Unit value=1,000 units
- (3) Cumulative value
- (4) Showa year designation (equivalents are also indicated)





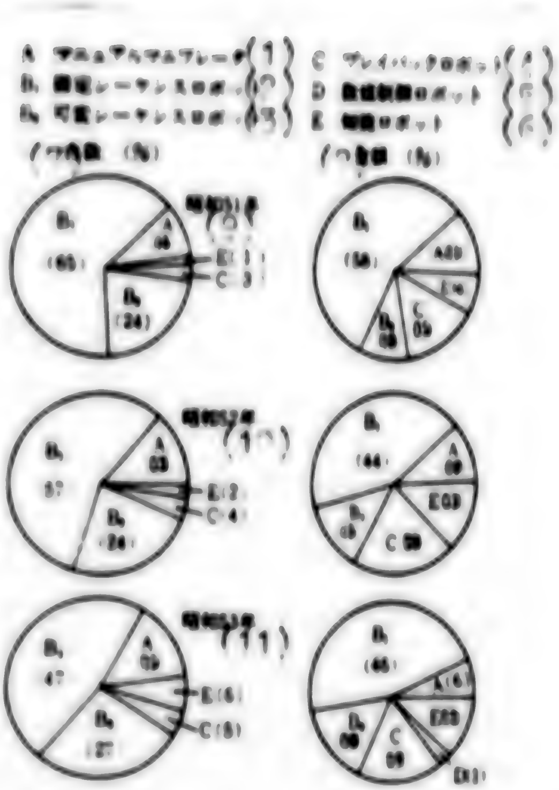


Figure 2. Annual Figures on Production Output of Industrial Robots

Key:
(1) Production output (amount in yen)
(2) Unit value=one billion yen
(3) Cumulative value
(4) Showa year designation (equivalents are also indicated)
(5) Forecast value

Figure 3. Production Percentages of Industrial Robots by Types and Year

Key:
(1) Manual manipulator
(2) Fixed sequence robot
(3) Variable sequence robot
(4) Playback robot
(5) Numerical controlled robot
(6) Intelligent robot
(7) Number of units by percentages
(8) Production amount by "
(9) 1976
(10) 1977
(11) 1978

(2) Movements in demand

The demand for industrial robots has spread throughout the entire industrial spectrum, but the principal demands in the various industries are: automobile industry (35 percent), electrical machinery and equipment manufacturing industry (25 percent), synthetic resin processing industry (8 percent), metal products manufacturing industry (7 percent), metal processing machinery manufacturing industry (5 percent), etc. (Figure 4)

The principal uses of the industrial robot in the various processes are cutting and grinding, pressing, resin forming, welding, casting, heat processing and assembling.

Hereafter, such operations as tightening screws, assembly, caulking, etc. are possible with functions from an artificial "brain" operated by computer, and advancements in application in complex assembly operations and in inspection processes are forecast.

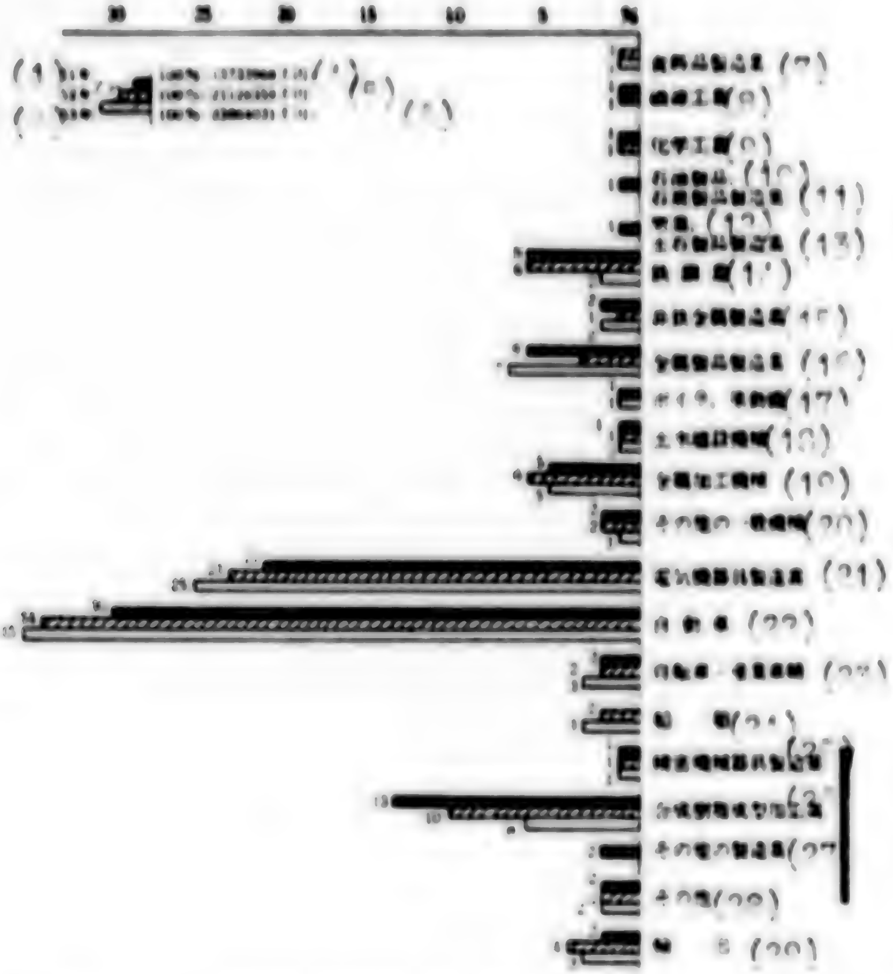


Figure 4. Demands of Industrial Robots in the Industries (expressed in percentages)

Key:

(1) Showa 51=1976
(2) Showa 52=1977
(3) Showa 53=1978
(4) 13,733,968 thousand yen
(5) 21,128,359 thousand yen
(6) 23,864,031 thousand yen
(7) Foodstuff manufacturing industry
(8) Textile industry
(9) Chemical industry
(10) Petroleum products
(11) Coal products manufacturing industry
(12) Ceramic industry
(13) Earthen and rock products industry
(14) Steel industry
(15) Non-ferrous metal manufacturing industry
(16) Metal products manufacturing industry
(17) Boiler and motors
(18) Building and construction machinery
(19) Metal processing machinery
(20) General type machinery
(21) Electrical machinery and equipment manufacturing industry
(22) Automobiles
(23) Bicycles and industrial vehicles
(24) Shipbuildings
(25) Precision machinery instruments manufacturing industry
(26) Synthetic resin mold processing industry
(27) Other manufacturing industries
(28) Others
(29) Exports

With the development of robots able to execute assembling operations, the demand in such industries as the electrical equipment manufacturing industry and general machinery manufacturing industry is expected to expand, and the demand for industrial robots which can be substituted for dangerous and rigorous operations and operations with adverse environmental conditions in the various industries will be greatly expanded.

(3) Movements in exports and imports

Since Japan is the leading nation in the world in the practical application of industrial robots, there is hardly any importing.

On the other hand, since there is emphasis on the development and use of this technology within Japan, exports are limited to 3-4 percent of the total production, but with the tremendous demand from the Western nations, USSR and the East European countries, it is estimated by 1985 the export ratio will be near 20 percent.

4. Promotion Measures for the Industrial Robot

Since its origin, the industrial robot has a very short history and the industry is an infantile one.

In Japan the industrial robot has taken its first step in the era of its full scale utilization. During this period, the industrial robot became a designated machine type with the "Emergency Measure Law for the Special Electronic Industry and Special Machinery Industry" enacted in 1971 and the "Emergency Measure Law to Promote the Special Machinery Information Industry" enacted and executed in July 1978, and by the early establishment of its industrial base, its growth and promotion were planned. The following promotional projects were considered to project its dissemination from this year:

(1) Industrial robot lease system. (Financing was advanced to establish the Japan Robot Lease Co., Ltd. in April 1980, as a lease company specializing in industrial robots.)

(2) Special repayment system for essential composite machinery. (Additional designation of the industrial robot for high performance electronic computer control.)

(3) Special financing system for industrial safety and health facilities. (Financing system used when small or medium enterprise purchases a labor saving industrial robot.)

(4) Capital loan system for modernizing facilities of small or medium enterprises. (Interest-free loan system used when a small or medium enterprise purchases an industrial robot.)

5. Problems from Standpoint of Using Industrial Robots

On the other side of the usefulness of the industrial robot lies the many restrictive conditions on importation of the industrial robot.

First, this does not apply to all the industrial robots, but there is a need to reappraise them for their economic value because of their high prices.

Second, systems engineering and the systems engineering business in Japan are not fully developed. A systems engineering optimizing the machinery system, which today has become multi-purpose, complex, highly developed and huge in size, is desired, and fostering an engineering business that would independently maintain business secrets is hoped for.

Third, heavy expenditures and much time would be required to develop technologies on industrial robot usage. And this would require considering the various ways and means to solve such problems as conditions required of the robot in terms of the type of machinery handled and its performance, accuracy of positional changes, cycle time, shape and weight of work handled, layout, differences in conditions of the environment, renovation of area so that the user can easily operate the industrial robot, such as on change of work facilities or layout change, etc.

Fourth, improve the reliability of the industrial robot; in other words, lengthen the interval between breakdowns.

Fifth, to optimize the system, Japan's long practiced tradition of ignoring to charge an engineering fee must be revamped.

Sixth, is the labor problem. Hardly any problems are encountered when installing robots in a newly built plant, but when installing in an established plant, the understanding of the workers must be obtained, a voluntary endorsement of the robots must be fostered and the workers must not be forcefully eliminated. While seeking a quality change of labor by installing the robots and having the workers be operators of the robots or be maintenance personnel, a reeducation program on the changes of roles must be instituted.

6. Outlook on the Robot Market

It is difficult to make a forecast with some degree of certainty on the future of the robot market because by nature it can be influenced by varying important factors. It is felt that big differences in forecast can occur depending on the cost of converting robot technology or robot-related technology to practical utilization; in other words, to the changes hereafter in cost performance and on the user's receptivity to such cost performance. For the present, while it is difficult to arrive at a quantitative assessment, the market forecast will undergo changes regardless of the influences of the cost performances from such indirect benefits as upgrading of product quality, elevating workmanship, increasing safety which are derivations of the robot system. Then from the medium and long range standpoint, the use of the intelligent robot will pose a big problem, but for the technological progress hereafter of the intelligent robot which has already reached the practical application level, the possibility of the formation of a large market is very likely to occur.

Next, the future of the several types of robots will be summarized:

(1) The simple loader/unloader type robot. A great deal of these robots have been imported to be used primarily with machine tools, pressing machines, plastic machines, etc. When considering the presence of a large number of these kinds of

machinery in Japan and the presence of machinery still without automation functions of loading and unloading during operations, and with no definite prospect of a competitive technology along automation, a stable growth hereafter is expected.

The possibilities of market expansion can be induced by the following:

(a) Use of robots with machinery (heretofore used with robots) which have not yet been automated. This is especially to increase its installation with machinery operated by small and medium enterprises.

(b) Expansion of the overseas market.

(c) Strengthening safety legislation.

(d) Technology to lower cost of unit; also, improvements in technology development.

(e) Occurrence of (replace?) demand.

The operations by the robots are comparatively simple and much of the operations are hazardous, to name a few of the merits of the robots whose performance can be given greater dissemination.

(2) Playback type robot. Because the minimum cost of a unit is 10 million yen, this robot is not cheap, but with such improvements as the introduction of the module design concept and installation of software support, its technology, beginning with welding and painting operations, has gradually expanded its scope of application. It is still a far cry from firming up the introduction of diversified small production processing, but with the sophistication of its high level functions such as addition of the sensor function, reduction of costs along with the dissemination of the modular robot which is dependent on the use of the standard unit, the practical application of a better diversified small quantity production processing will become a possibility. At the same time, this possibility is not totally limited to this robot type, but the development of hands that can grasp even softer objects to play a big role is expected.

(3) Intelligent robot. The influence that the intelligent robot can wield in the expansion of the entire robot market is forecasted to be tremendous. This type of industrial robot which uses pattern recognition as a means of recognizing information of the outside world can be applied first of all in high level assembling and inspection processes within the factory production line and successively it is possible to have the robot engage in various outdoor operations. In particular, the automation of assembling and inspection processes, when compared with machine processing, is relatively poorer in performances as a process and so the intelligent robot is said to have a big potential market.

(4) New Application Fields for the Robot. With the technological progress of the robot hereafter, especially with the progress of the technology of the intelligent robot as a prerequisite, the unfolding of many, new fields of application are anticipated. Some of the representative ones are given as follows:

(1) Application in the nuclear power related field. Use for various purposes such as the various handling operations in the nuclear power plant, the radioactive waste material processing stages, etc., checking plant conditions, periodic inspections, etc.

(2) Application in the medical and welfare related fields. Apply robot technology in the development of various systems, such as assisting the physically handicapped or the bedridden old person with his daily routine, assisting the nurses, making preparations for surgery, for firefighting, for rescue work, removal of dangerous matter, cleanup, etc.

(3) Application in the oceanic development related field. Robots to conduct various handling operations for the construction of underwater structures, underwater machinery processing, multi-purpose observation, etc.

(4) Application in agriculture and forestry. Applications of robot technology in agriculture and forestry, such as fruit harvesting, spraying agricultural chemicals, logging, pruning, gathering branches, etc.

(5) Application in construction. Apply robot technology for such operations as steel reinforcement framework, bridge painting, joining the outer and inner trimmings of a high rise structure.

(6) Application of robot technology in service industries is anticipated.

The progress of robot technology has possibilities in successive development in new fields as cited above.

Supplementary Funds

Tokyo KOGYO GIJUTSU in Japanese Vol 21, No 6 Jun 80 pp 68-69

[Article by Koshin Kura of the Technology Promotion Section, Agency of Industrial Science and Technology, MITI: "On Decisions to Furnish Supplementary Funds for the 1980 Major Technological R&D"]

[Text] 1. The Subsidy System for Research and Development of Major Technologies

The purpose of this system is to foster research and development by granting subsidies for projects connected with the following research and development themes: on the major technologies which are expected to be the basis for promoting the conversion of Japan's industrial structure to a knowledge-intensive one; on housing systems technology; on hitherto unexplored innovative technologies which will be the basis for the innovative technologies of the next generation and will take the initiative to exert great influence, and on environment preservation, safety measure and energy saving technologies whose developments are urgently sought.

2. Summary of Applications for Grants

Applications for this year's grants were accepted from 1 February 1980 (Friday) with the announcement of an outline on grant applications and were closed on 29 February 1980 (Friday). The number of applications received was 137. (Table 1) The amount of money applied for was 5.7 billion yen.

3. Summary of the Screening of Grants

The screening was based on "The Outline of Screening Procedures for Granting Subsidies for Research and Development of Major Technologies," and the purpose was to actively select research and development projects with high technological standards and far-reaching lateral contributions, and especially considered essential from the standpoint of the nation's economic and social welfare.

As in the past, a deliberate and fair screening was first conducted in MITI and then the opinions of a "technical committee" composed of staff members of MITI departments and bureaus were solicited.

4. Summary of Candidates for Grants

From the screening described above, the list of grants was compiled as shown in "Data" on page 81. [Error for page 85. See Part C, this report for translation] A summary of the data follows:

(1) There are 54 grants with themes on core technologies and others. (Table 2)

(a) A total of 28 pertains to core technologies. The breakdown is: three in the machiney category, 17 in the electrical category, six in the chemical and textile category and two in the metals category.

Two of the subjects are "Research and trial manufacture of an intelligent, compound, automated measurement system utilizing LSI" and "Applied research on manufacture of diamond monocrystals for industrial use."

(b) A total of four subjects pertains to major technologies.

(c) A total of two subjects pertains to housing systems technology.

(d) A total of 20 subjects pertains to hitherto unexplored innovative technologies: two on optoelectronics, three on high level measurement, three on comprehensive utilization of carbon, six on utilization of enzymes and microorganisms, five on new materials and one on new electronic devices.

Two of the subjects are "Research on method of detecting temperature within the living body" and "Research on Josephson's integrated circuit."

(2) A total of 18 grants is made for environment preservation and safety measure technologies: 12 on environment preservation, namely air pollution prevention, water pollution prevention and waste disposal; six on safety measure technologies, namely industrial disaster and safety measures for machinery and tools relative to community safety.

Two of the subjects are "Industrial test of hermetically sealed type coal storage and handling facilities" and "Research and trial tunnel excavator."

(3) A total of 12 grants is made for energy saving technologies whose development is urgently sought. These are technologies on saving energy in production processes, saving energy in energy consuming machinery and equipment, on peripheral auxiliary machinery and tools, and on materials.

Two of the subjects are "Research and trial manufacture of a high efficiency engine using gas as fuel" and "Industrialization test on development of an energy saving ceramic heat exchanger."

(4) A total of 84 grants was made totalling 3,117,570,000 yen.

(5) The distinguishing characteristics of the 1980 subsidies for research and development of major technologies are: (1) an increase in the number of grants for research and development subjects which, being difficult for a single firm to carry out, are performed jointly by several firms or research associations (seven grants for joint research and three by research associations in 1978; eight for joint research and four by research associations in 1979; and 10 for joint research and five by research associations in 1980); (2) an increase in the number of grants for energy saving technologies and basic research technologies which are important from the standpoint of government policy (six grants for energy saving technologies and 19 for basic research technologies in 1979, and 12 for energy saving technologies and 20 for basic research technologies in 1980); and (3) an increase in the number of grants for large scale research and development (subsidies of over 100 million yen). There were three such grants in 1979 and four in 1980.

Table 1. Number of Applications and Grants

Classification		Number of Applications	Number of Grants
Core technologies and others	Core technologies	54	28
	Priority technologies	8	4
	Housing systems technology	3	2
	Hitherto unexplored innovative technologies	26	20
	Subtotal	91	54
Environment preservation and safety measure technologies		26	18
	Total	117	72
Energy saving technologies		20	12
	Grand total	137	84

Table 2. Number of Grants by the Trade and Industry Bureau

Classification		Sapporo	Tokyo	Nagoya	Osaka	Hiroshima	Fukuoka	Total
Core technologies and others	Core technologies	1	13	1	11	1	1	28
	Priority technologies			1	2	1	1	4 [sic]
	Housing systems technology		1		1			2
	Hitherto unexplored innovative technologies		14	2	1	2	1	20
	Subtotal	1	28	4	15	4	2	54
Environment preservation and safety measure technologies			12		5	1		18
	Total	1	40	4	20	5	2	72
Energy saving technologies			6		3	1	2	12
	Grand total	1	46	4	23	6	4	84

Development Plans

Tokyo KOGYO GIJUTSU in Japanese Vol 21, No 6, Jun 80 pp 83-92

[Text] B. Technological R&D in the Fields of Medicine and Welfare

A consignment system for technological research and development of medical and welfare equipment was inaugurated in 1976 with the government paying consignment expenses to agencies having the capabilities to undertake research and development of equipment whose development is newly requested in the medical and welfare fields. Results like those indicated below have already been obtained. An outline of the results obtained is presented below. Research and development of nine pieces of equipment are in progress at present.

	Automatic Hemogram Analyzer	Module-Type Electrically Driven Wheel Chair	Braille Reproduction Device
Outline of Development	Developed an apparatus that automatically analyzes hemograms by the pattern recognition method. Its accuracy is about the same as that for the testing technician (agreement rate over 95 percent) and has about 10 times greater processing speed (over 50 test objects/hour).	Planned to reduce costs by building components into modules and developed an electrically driven wheel chair that can be adapted to various degrees of handicap. Has an automatic control system, a bright design, a non-leaking fluid battery and other new features.	Developed a device that can read braille optically and reproduce one copy (braille typed on electrically driven typewriter) to several hundred copies (blister printed baille). At the same time, the device can easily do such things as convert braille to/from kana, edit, proofread and keep records
Principal Functions	Analysis items: Six classification of normal white blood cells, four classifications of abnormal white blood cells, detection of morphological and staining abnormalities of red blood cells. Preliminary processing device: Automatic smearing and automatic staining of 50 test objects.	Three models: The extremely handicapped, the severely handicapped and the slightly handicapped persons. Travel distance: About 20 km. Speed: 2 km/H to 6 km/H Weight: 55 to 70 kb. Climbable angle: 15° Surmountable step difference: 35 mm	Braille reading speed: 30 seconds per sheet. Reproduction time for one copy is about 3 minutes and reproduction time for many copies is 600 sheets per hour. There are three input methods: braille reading, kana and braille. There are two output methods: braille and kana.
Future Tasks	Accumulation of field data	Cost reduction	For dissemination abroad, make it possible to use both A and B editions

	Automatic Hemogram Analyzer	Module-Type Electrically Driven Wheel Chair	Braille Reproduction Device
Anticipated Price (varies with specifications and performances)	About 30 million yen	340,000 yen	The system: 7.8 million yen; manual typewriter: 50,000 yen and the electric typewriter: 70,000 yen
Destination of Disseminated Units	General hospitals, blood testing centers, health examination centers, etc.	Physically handicapped persons, the aged, etc.	Blind persons, braille translation volunteers, braille libraries of schools for the blind, entrance exam centers of state universities, etc.
Number of Units Expected to be Dissimenated	1980-1984: about 150 units	Provided at public expense: About 600 units. Purchase by general public: About 800 units (annual number)	About 70 units of the system.
	Device for Training and Restoring Functions of the Physically Handicapped	Multi-function Bed for Severely Handicapped Persons	Multi-item Automatic Biochemical Analyzer
Outline of Development Results	Developed a system which optically analyzes at 16 points the walking patterns of persons not having free use of their limbs; with a large force plate also analyzes the shifting of the center of gravity. Also developed a device for measuring muscular strength.	Developed a multi-function bed for the severely handicapped who can defecate on the bed (electrically operated set chamber pot); can urinate on the bed (automatic detection and suction type separation bedpan) and can safely bathe on the bed with a simple bathtub.	Developed a high speed multi-item biochemical automatic analyzer capable of processing 300 test objects per hour and simultaneously analyzing 30 items. For high speed and low cost, new ideas on measuring are being considered.

	Device for Training and Restoring Functions of the Physically Handicapped	Multi-function Bed for Severely Handicapped Persons	Multi-item Automatic Biochemical Analyzer
Principal Functions	Capable of measuring a maximum of 16 points by semiconductor positional value detection sensors. Large force plate: 400 x 1,000 mmMo-100 Hg. 12 kinds of display software. A muscular strength measuring device adaptable to various kinds of handicap.	Disposal of defecation by means of an electrically operated set chamber pot; disposal of defecation by means of separation urinal; showering with a simple bathtub; an air type device to prevent bed-sore; an electrically driven mechanism for back raising and for up and down movements; weight: 123 kg.	Maximum number of items analyzed simultaneously: 30; processing capability: 300 test objects per hour. reaction section: (sheeto) method: amount of serum needed: 5-30 μℓ per item; amount of reagent needed: 330-405 μℓ per item; measuring methods: color comparison, UV and flame light.
Future Tasks	Upgrading the resolving power of the image detector method and converting it to subsystems.	System conversion and cost reduction to meet the requirements of a wide range of patients.	Accumulation of field data and development of a preliminary processing apparatus.
Anticipated Price (varies with specifications and performances)	Depending on system specifications: 2.5 to 7.5 million yen.	About 400,000 yen	About 30 million yen
Destinations of Disseminated Units	Hospitals, rehabilitation and treatment agencies for the physically handicapped	Hospitals, facilities for severely handicapped persons, special nursing homes for the aged, homes of bedridden old persons.	General hospitals, inspection centers, health exam centers, etc.
Number of Units Expected to be Disseminated	About 40 units of the system (in 5 years)	1980-1984: About 7,000 units	1980-1984: About 200 to 250 units

C. Supplemental Funds for 1980 Major Technological R&D

1. Core Technologies and Others (54 items)

(1) Core and Priority Technologies (32 items)

(Machinery Category)

No.	Classified by Trade & Industry Bureau	Types of Subsidy	Subjects	Recipients of Subsidies	Remarks
1	Tokyo	Applied research	Research and Development of fluid transport device for solid fluid mixed flow	Niigata Iron Works	Core technology; 3rd year of 3-year plan
2	Tokyo	Research and trial manufacture	Research and trial manufacture of a comprehensive evaluation system for large antifriction bearings	NTN Toyo Bearing Co., Ltd. Koyo Seiko Co. Ltd.; Nippon Seiko Co., Ltd. Fujikoshi, Ltd.	Core technology; 3rd year of 3-year plan
3	Hiroshima	Industrialization test	Industrialization test on development of computer systems for clothing designs and for trial manufacturing processes	Asahi Chemical Industry Co., Ltd. and Okasan Co., Ltd.	
4	Nagoya	Applied research	Applied research on heat exchanger pipes for electric power generation utilizing ocean temperature differences	Sumitomo Light Metals Industries	
5	Osaka	Research and trial manufacture	Research and trial manufacture of an apparatus for tissue culture and cell fractionation	Miki Engineering Co., Ltd.	Core technology; 3rd year of 3-year plan; small and medium

(Electrical Category)

No.	Classified by Trade & Industry Bureau	Types of Subsidy	Subjects	Recipients of Subsidies	Remarks
6	Tokyo	Applied research	Applied research on smart sensors	Adachi Electric Co., Ltd.	Core technology; 2nd year of 3-year plan
7	Tokyo	Applied research	Applied research on an integrated (Kaiseki) circuit using gallium arsenide field effect transistors	Fujitsu, Ltd.	Core technology; 3rd year of 4-year plan
8	Tokyo	Applied research	Applied research on laser gyro	Japan Aviation Electronics Industry, Ltd.	Core technology; 2nd year of 2-year plan
9	Tokyo	Applied research	Applied research on a recording medium for high density vertical magnetic recorder	Tokyo Shibaura Electric Co., Ltd. and Nichiden Aneruba Co., Ltd.	Core technology; 1st year of 2-year plan
10	Tokyo	Research and trial manufacture	Research and trial manufacture of an intelligent, compound, automated measuring system utilizing LSI	Automated Measuring Technology Research Association	Core technology; 1st year of 3-year plan
11	Tokyo	Research and trial manufacture	Research and trial manufacture of a high definition, liquid crystal display device	Takeda Riken Industry Co., Ltd.	Core technology; 2nd year of 2-year plan
12	Tokyo	Research and trial manufacture	Research and trial manufacture of a high definition, liquid crystal display device	Hitachi, Ltd.	Core technology; 3rd year of 3-year plan
13	Tokyo	Research and trial manufacture	Research and trial manufacture of a circuit breaking method for DC power transmission system	Tokyo Shibaura Electric Co., Ltd.	Core technology; 3rd year of 4-year plan
14	Tokyo	Applied research	Applied research on two-dimensional measurement of faint light	Hamamatsu TV Co., Ltd.	Core technology; 1st year of 3-year plan

No.	Classified by Trade & Industry Bureau	Types of Subsidy	Subjects	Recipients of Subsidies	Remarks
15	Osaka	Applied research	Applied research on a high speed, high precision A/D switch for image processing	Matsushita Electrical Industrial Co., Ltd.	Core technology; 2nd year of 3-year plan
16	Osaka	Applied Research	Applied research on planar-type, high density color (three colors) LED display device	Sanyo Electric Co., Ltd.	Core technology; 2nd year of 3-year plan
17	Osaka	Applied Research	Applied research on a 500 KV series capacitor	Nisshin Electric Co., Ltd.	Core technology; 2nd year of 3-year plan
18	Osaka	Applied Research	Applied research on a color, liquid crystal matrix display	Hoshi Electrical Manufacturing Co., Ltd.	Core technology; 1st year of 2-year plan
19	Osaka	Research and trial manufacture	Research and trial manufacture of a superconducting (period phase adjuster)	Mitsubishi Electrical Corporation and Fuji Electric Co., Ltd.	Core technology; 4th year of 5-year plan
20	Osaka	Research and trial manufacture	Research and trial manufacture of a protein quantitative analyzer based on immunoelectrophoresis	Toa Medical Electronics, Co. Ltd.	Core technology; 2nd year of 2-year plan; small and medium
21	Osaka	Industrialization test	Industrialization test of high precision, large aperture SOS base plate	Kyoto Ceramics Co., Ltd.	Core technology; 1st year of 2-year plan
22	Hiroshima	Research and trial manufacture	Research and trial manufacture of an automated clinical test apparatus based on high speed liquid chromatography	Toyo Soda Co., Ltd.	Core technology; 2nd year of 3-year plan

(Chemical and Textile Category)

No.	Classified by Trade & Industry Bureau	Types of Subsidy	Subjects	Recipients of Subsidies	Remarks
23	Tokyo	Applied research	Applied research on synthesis of a new polyimide from a new tetra-basic anhydride	Dai Nippon Ink Chemical Industry Co., Ltd.	Core technology; 2nd year of 3-year plan
24	Tokyo	Applied Research	Applied research on manufacturing enzymes for medical use from tissue culture	Asahi Chemical Industry Co., Ltd.	Core technology; 1st year of 2-year plan
25	Nagoya	Applied research	Applied research on atmospheric-pressurization sintering method for nitrogen silicon ceramics	NGK Spark Plug Co., Ltd.	Core technology; 1st year of 2-year plan
26	Osaka	Applied research	Applied research on manufacture of high grade, finely ground, nitrided silicon powder	Toyo Rayon Co., Ltd.	
27	Osaka	Applied research	Applied research on a method of manufacturing aromatic acetoxy-carbonic acid	Ueno Pharmaceutical Co., Ltd.	Small and medium
28	Osaka	Applied research	Applied research on composite materials reinforced with alumina fibers	Sumitomo Chemical Co., Ltd.	Core technology; 1st year of 2-year plan
29	Osaka	Applied research	Applied research on manufacture of diamond monocrystals for industrial use	Sumitomo Electric Industries, Ltd.	Core technology; 1st year of 3-year plan
30	Fukuoka	Industrialization test	Industrialization test on manufacture of polyester polycarbonate resin	Mitsubishi Chemical Industries Co., Ltd.	Core technology; 1st year of 2-year plan

(Metals Category)

No.	Classified by Trade & Industry Bureau	Types of Subsidy	Subjects	Recipients of Subsidies	Remarks
31	Sapporo	Applied research	Applied research on non-ferrous metal clad sheet steel	The Japan Steel Works, Ltd.	Core technology; 1st year of 3-year plan
32	Osaka	Applied research	Applied research on manufacture of atomized iron powder for large sinters and forged sinter products	Sumitomo Metal Industries, Ltd.	Core technology; 2nd year pf 2-year plan
(2) Housing System Technology (2 items)					
33	Tokyo	Research and trial manufacture	Research and trial manufacture of a gas heat pump	Tokyo Gas Co., Ltd.	2nd year of 3-year plan
34	Osaka	Applied research	Applied research on a hybrid air conditioner	Matsushita Electrical Industrial Co., Ltd. and Daikin Kogyo Co., Ltd.	3rd year of 3-year plan
(3) Hitherto Unexplored Innovative Technologies (20 items)					
35	Tokyo	Hitherto unexplored innovative technology	Research on an optical element manufacturing technology based on a multifunction, molecular beam epitaxial growth apparatus	Ulvac Corporation	Optoelectronics; 2nd year of 3-year plan
36	Tokyo	Hitherto unexplored innovative technology	Research on materials for optical memory	Oki Electric Industry Co., Ltd.	Optoelectronics; 1st year of 3-year plan
37	Tokyo	Hitherto unexplored innovative technology	Research on a method of detecting temperature within the living body	Medical and Welfare Equipment Research Institute of the Technology Research Association	High order measurement; 1st year of 3-year plan

No.	Classified by Trade & Industry Bureau	Types of Subsidy	Subjects	Recipients of Subsidies	Remarks
38	Tokyo	Hitherto unexplored innovative technology	Research on a high order measuring method applying visual functions of living body	Nippon Electric Co., Ltd.	High order measurement; 4th year of 5-year plan
39	Hiroshima	"	Research on monitoring of a living body by means of microsensors utilizing gate insulated field effect transistors	KURARAY Co., Ltd.	High order measurement; 2nd year of 3-year plan
40	Tokyo	"	Research on carbon fibers made from pitch	Nippon Carbon Co., Ltd.	Comprehensive utilization of carbon; 1st year of 2-year plan
41	Tokyo	"	Research on carbon membrane	Central Research Lab of Mitsubishi Metal Corporation	Comprehensive utilization of carbon; 1st year of 2-year plan
42	Fukuoka	"	Research on carbon fibers made from depolymerized coal	Mitsui Cokes Industry Co., Ltd.	Comprehensive utilization of carbon; 1st year of 3-year plan
43	Tokyo	"	Research on a method of identifying physiologically active substances by means of near infrared rays	Mitsubishi Chemical Industries Co., Ltd.	Enzymes and microorganisms; 2nd year of 2-year plan
44	Tokyo	"	Research on a method of measuring the constituents of a living body by means of enzyme sensors	Toyo Brewing Co., Ltd.	Enzymes and microorganisms; 1st year of 3-year plan
45	Tokyo	"	Research on function accelerating substances produced by microorganisms	Nippi Co., Ltd.	Enzymes and microorganisms; 1st year of 3-year plan

No.	Classified by Trade & Industry Bureau	Types of Subsidy	Subjects	Recipients of Subsidies	Remarks
46	Nagoya	Hitherto unexplored innovative technology	Research on effective utilization of useful microorganisms by means of light quality	Nippon Carbide Co., Ltd.	Enzymes and microorganisms; 1st year of 3-year plan
47	Nagoya	"	Development of technology for separation and dispersion of constituents of a living body	Medekusu Co., Ltd.	Enzymes and microorganisms; 2nd year of 3-year plan; small and medium
48	Hiroshima	"	Development of a new cancer diagnosis system based on an enzyme method	Tokuyama Soda Co., Ltd.	Enzymes and microorganisms; 2nd year of 3-year plan; small and medium
49	Tokyo	"	Research on a method of generating super high pressure and on new materials applying this method	Inoue Japax Research Institute	New materials; 2nd year of 3-year plan; small and medium
50	Tokyo	"	Research and development of medical materials made of fluorine resin having (nishinsei)	Asahi Glass Co., Ltd.	New materials; 2nd year of e-year plan; small and medium
51	Tokyo	"	Research on an elementary shaped material made of alloy fortified by grain dispersion	Central Research Lab of Mitsubishi Metal Corporation	New materials; 2nd year of 4-year plan
52	Tokyo	"	Development of a composite membrane material possessing high weather resistance and high strength	Toyo Textile Co., Ltd.; Asahi Chemical Industry Co., Ltd.; Asahi Glass Co., Ltd.; Sumitomo Electric Industries, Ltd.; Teijin, Ltd.,; Toyo Rayon Co., Ltd. and KURARAY Co., Ltd.	New materials; 2nd year of 3-year plan

No.	Classified by Trade & Industry Bureau	Types of Subsidy	Subjects	Recipients of Subsidies	Remarks
53	Osaka	Hitherto unexplored innovative technology	Research on high performance materials by means of plastic treatment	Sekisui Chemical Co., Ltd.	New materials; 1st year of 2-year plan
54	Tokyo	"	Research on Josephson's integrated circuit	Nippon Electric Co., Ltd.; Hitachi, Ltd.; Fujitsu, Ltd. and Mitsubishi Electric Corporation	New electronic device; 1st year of 4 year plan
2.	Environment Preservation and Safety Measure Technologies (18 items)				
55	Tokyo	Applied research	Applied research on the improvement of quality of resin molded products	Shinetsu Chemical Industry Co., Ltd.	2nd year of 2-year plan
56	Tokyo	Applied research	Applied research on a safety measure technology for medical care equipment	Medical and Welfare Equipment Research Institute of the Technology Research Association	1st year of 3-year plan
57	Tokyo	Industrialization test	Industrialization test on piston rings and cylinder linings in diesel engines for pollution prevention and energy saving	Nippon Piston Rings Co., Ltd.	2nd year of 2-year plan
58	Tokyo	Industrialization test	Industrialization test of heremetically sealed coal storage and handling facilities	Obayashi Gumi, Ltd.	
59	Tokyo	Industrialization test	Industrialization test of rubbing materials containing steel wool for automobile use	Akebono Brake Industry Co., Ltd.	2nd year of 3-year plan
60	Tokyo	Experimental	Trial manufacture for practical application of noise reduction of large trucks, etc.	Isuzu Motors Co., Ltd.; Nisson Diesel Industry Co., Ltd.; Hino Motors, Ltd. and Mitsubishi Motor, Ltd.	1st year of 3-year plan

No.	Classified by Trade & Industry Bureau	Types of Subsidy	Subjects	Recipients of Subsidies	Remarks
61	Tokyo	Research and trial manufacture	Research and trial manufacture of high output klystron for treating industrial waste	Tokyo Shibaura Electric Co., Ltd.	2nd year of 3-year plan
62	Tokyo	"	Research and trial manufacture of a plasma surface treatment apparatus	Citizen Watch Co., Ltd.	2nd year of 2-year plan
63	Tokyo	Experimental and trial manufacture	Trial manufacture of a high strength turbine impeller based on precision casting	Ebara Manufacturing Co., Ltd.	1st year of 3-year plan
64	Tokyo	Research and trial manufacture	Research and trial manufacture on profiling control of a whole profile tunnel excavator	Sanwa Machine Parts, Co., Ltd.	Small and medium
65	Tokyo	Applied research	Applied research on an impression plate output technology based on electron beam scanning	Shaken Co., Ltd.	Small and medium
66	Tokyo	Applied research	Applied research on the manufacture of high aspect ratio mica flakes and high performance composite substances	Repuko Co., Ltd.	2nd year of 3-year plan
67	Osaka	Industrialization test	Industrialization test on the catalytic hydrogenizing decomposition treatment of organic chlorine compounds	Daido Oxygen Co., Ltd.	1st year of 2-year plan
68	Osaka	Research and trial manufacture	Research and trial manufacture of an optimum engine control system for energy saving purpose	Safety and Pollution Technology Research Association of Automobile Manufacturers	2nd year of 2-year plan
69	Osaka	Experimental	Trial manufacture of a safety automation system for finishing large castings	Kobe Steel, Ltd.	2nd year of 4-year plan

No.	Classified by Trade & Industry Bureau	Types of Subsidy	Subjects	Recipients of Subsidies	Remarks
70	Osaka	Commercialization development	Commercialization development of a dry type dust collector for blast furnace top gas	Kobe Steel, Ltd.	
71	Osaka	Applied research	Applied research on a new magnetic core material for electrical equipment	Matsushita Electrical Industrial Co., Ltd.	1st year of 3-year plan
72	Hiroshima	Applied research	Applied research on an oxygen enrichment system based on gas separation membrane	Teijin Limited;Asahi Glass Co., Ltd.; Sumitomo Electric Industries Ltd.; Toyobo Co., Ltd.; Toyo Rayon Co., Ltd.; Asahi Chemical Industry Co., Ltd., and KURARAY Co., Ltd.	2nd year of 2-year plan
3.	Energy Saving Technology (12 items)				
73	Tokyo	Applied research	Applied research on an instantaneous-starting, high efficiency miniature discharge lamp	Mitsubishi Electrical Corporation	2nd year of 2-year plan
74	Tokyo	Applied research	Applied research on energy saving with antifriction bearing production processes	NTN Toyo Bearing Co., Ltd.	1st year of 2-year plan
75	Tokyo	Industrialization Test	Industrialization test of a standard, practical electric automobile	Technical Research Association on Electric Cars for Standard Use	3rd year of 5-year plan
76	Tokyo	Industrialization Test	Industrialization test of a large reflecting mirror processing high weather resistance and high reflectance	NHK Spring Co., Ltd.	1st year of 2-year plan

No.	Classified by Trade & Industry Bureau	Types of Subsidy	Subjects	Recipients of Subsidies	Remarks
77	Tokyo	Research and trial manufacture	Research and trial manufacture of a (Ranking Botoming) engine	Komatsu Ltd.	1st year of 3-year plan
78	Tokyo	Research and trial manufacture	Research and trial manufacture of a room cooling, heating and hot water and supply system powered by gas engine	Komatsu Zenoa Co., Ltd.; Maekawa Manufacturing Co., Ltd. and Nagao Manufacturing Co., Ltd.	1st year of 3-year plan
79	Osaka	Applied research	Applied research on a heat driven engine utilizing a shape remembering alloy	Sharp Corporation	1st year of 2-year plan
80	Osaka	Applied research	Applied research on the development of an image display method using low power consumption CRT	Sanyo Electric Co., Ltd.	1st year of 3-year plan
81	Osaka	Applied research	Applied research on a dynamic pressure gas bearing for air cycle machines used in aircraft	Shimadzu Seisakusho Ltd.	
82	Hiroshima	Research and trial manufacture	Research and trial manufacture of a high efficiency engine using gas as fuel	Mitsui Shipbuilding and Engineering Co., Ltd.	1st year of 2-year plan
83	Fukuoka	Applied research	Applied research on a diesel engine made of ceramics	Kyoto Ceramic Co., Ltd.	3rd year of 3-year plan
84	Fukuoka	Industrialization test	Industrialization test on development of an energy saving ceramic heat exchanger	Kurosaki Refractories Co., Ltd.	1st year of 3-year plan

D. The Technological Advisory System

[by Akira Ito, Technology Section, Guidance Department, Agency of Small and Medium Enterprises, MITI]

1. Purpose of This System

The environment that has surrounded Japan's small and medium enterprises in recent years holds in it many problems--fierce competition from developing nations, diversification and elevation of consumer needs, an increase in restrictions to save resources and energy, etc.--that require immediate confrontation.

Japan's small and medium enterprises still occupy a firm position in the nation's economy, but if they are to develop soundly as the "forceful many" in the 1980's in such an environment, then it is imperative that stronger measures than before be taken to augment and strengthen their business resources so as to be able to cope accurately and quickly with the various changes in the environment.

Moreover, Japan's small and medium enterprises, to overcome these changes in the environment and to find their way out of future difficulties, must strengthen their technology development capabilities to develop new products and technologies, produce higher level products, obtain greater added values, reduce production costs, save resources and energy, etc.

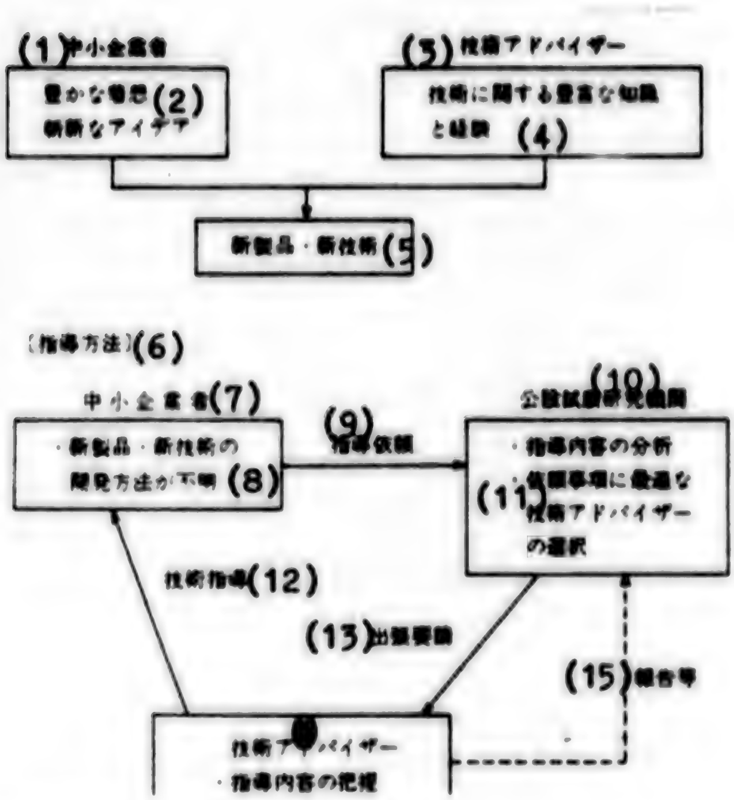
Although Japan's small and medium enterprises have continued with sustained efforts to strengthen their technology development capabilities, the present situation is one where they alone cannot execute because of such problems as shortage of technicians, inadequacy of facilities, insufficiency of funds for technology development and scarcity of technological information.

For these reasons, the Agency of Small and Medium Enterprises and the prefectural governments have instituted measures to furnish small and medium enterprises with technology guidance, assistance and support in technology development, technological training, technology information, etc., and are endeavoring to eliminate or alleviate restrictions so that small and medium enterprises can strengthen their technology developing capabilities.

The technological advisory system was established to plan for the healthy growth of small and medium enterprises by promoting their technology developing capabilities which have become even more important than before.

This system is to promote the development of new products and technologies by small and medium enterprises by drastically improving the technological advisory system which hitherto had been conducted mainly by public experiment or research agencies, such as the prefectural industrial experiment stations. Civilians possessing ample technological knowledge and experience in fields which small and medium enterprises require long term and individualized technological guidance to develop new products and technologies will be registered and stationed at the prefectures as technology advisers. They will give on request appropriate guidance to small and medium enterprises which, because of the lack of technology developing capabilities, are unable to translate their abundant concepts and novel ideas into the development of new products and technologies.

Technological Advisory System



Key:
(1) Small or medium enterprise operator
(2) Abundance of concepts; novel ideas
(3) Technology adviser
(4) Abundance of knowledge and experience on technological matters
(5) New products and technologies
(6) Guidance method
(7) Small or medium enterprise operator
(8) Has no knowledge on developing new product or new technology
(9) Request for guidance
(10) Public experiment or research agency
(11) Analyzes request for guidance. Selects most suited technology adviser
(12) Technological guidance
(13) Request to have adviser dispatched
(14) Technology adviser; his grasp of the guidance request
(15) Reports, etc.

2. Outline of This System

Each prefecture will review the situation of the small and medium enterprises and the industrial development plans of the prefecture, and then determine the number of technology advisers to be registered and stationed. Generally about 20 technology advisers will be recruited in each prefecture.

To qualify as a technology adviser, one must (1) have over 20 years of actual experience in work related to technology matters, (2) be a professor or assistant professor of a natural science subject at a university, junior college or higher technical school, (3) have received a doctor's degree for research on a natural science subject, (4) have over 8 years of actual experience as a technician in technological work or have sufficient expert knowledge and experience to give technological guidance to small and medium enterprises.

Persons selected with these criteria will be commissioned as technology advisers by the prefectural governor.

The technology adviser will provide technology guidance in accordance with the technological level of the small or medium enterprise requesting guidance at the production site, the public experiment or research agency (open laboratory), etc.

Guidance by a technology guidance can be obtained continuously. When developing a new product, advice can be obtained stage by stage from concept planning, designing, trial manufacturing to commercial production. Normally an enterprise can receive guidance on an average of five times a year, up to a maximum of ten times.

Furthermore, guidance given by a technology adviser will, as a rule, be free.

Guidance requests from small and medium enterprises will be cleared through a technological advisory office established at the prefectural commerce and industry section or the public experiment or research agency. The prefectures will ask the central committee of the Small and Medium Enterprises Association, Chamber of Commerce, business organizations, the Subcontracting Enterprises Promotion Association and other related small and medium enterprise organizations to cooperate with the system in such matters as its popularization, education, and in assisting small and medium enterprises to seek technological guidance.

The plan is to inaugurate the technological advisory system in July 1980.

Persons desiring details about the technological advisory system or desiring guidance from a technology adviser can apply at the agencies mentioned above.

9510
CSO: 8129/1497

TESTS OF APR-4 WARNING SYSTEM START ON C-1 TRANSPORT

Tokyo JPE AVIATION REPORT-WEEKLY in English 3 Dec 80 pp 6-7

[Text] Airborne tests of a prototype XJ/APR-4 radar warning system for the F-15J started on a C-1 transport early in November as Tokyo Keiki Co., the prime contractor for development and production of the system, completed fabrication of two prototype sets. Another prototype will be used for reliability and other tests.

The TR&DI ordered the two prototypes in FY 1978 when the JDA placed the first APR-4 order with the firm to cover 23 F-15J and DJs.

A ¥26,221,000 contract was given to KHI in FY 1979 for modification of a C-1 to accommodate the test-model APR-4 system. The C-1 belongs to the first transport squadron of the ASDF Air Transport Wing.

Airborne tests at the Air Proving Wing will last until the end of February 1981.

The TR&DI will also hand a ¥4,598,000 contract to KHI shortly for restoration of the C-1 to its original state after the airborne APR-4 tests. Restoration will be carried out at KHI's Gifu Works from March 1 to 20 next year, and then the C-1 will be returned to the first transport squadron.

CSO: 4120

TR&DI TO TEST 120MM GUN FOR NEW MBT IN LATE NOVEMBER

Tokyo JPE AVIATION REPORT-WEEKLY in English 3 Dec 80 p 7

[Text] The TR&DI will conduct technical evaluation tests in late November on a 120mm smooth bore gun and its ammunition for a new main battle tank (MBT) being developed.

The tests are expected to pave the way for final adoption of the domestically developed gun and ammunition, although some quarters have recommended selection of Rheinmetall GmbH's 120mm smooth bore gun for the MBT. The West German gun is used on the US Army's XM-1 tank.

If the domestic gun and ammunition pass the tests, their full-size fabrication will start in FY 1982.

The gun's barrel for the tests has been built by Japan Steel Works Ltd. and the ammunition by Daikin Kogyo Co. and Komatsu Ltd.

CSO: 4120

MITI INAUGURATES STUDY GROUP ON SPACE INDUSTRY

Tokyo JPE AVIATION REPORT-WEEKLY in English 3 Dec 80 pp 7-8

[Text] The Ministry of International Trade and Industry (MITI) last week inaugurated a study group on basic issues related to space industry. The group headed by Prof. Hiroshi Hirayama of the Faculty of Science and Technology, Waseda University, will study the problems and prospects which the Japanese space industry is presently facing, the position of the industry in the present Japanese economic setup and measures to help promote it. The group will compile a report and recommendations by the end of this fiscal year, or the end of March 1981 and submit them to MITI's Aircraft and Machinery Industry Council for study.

Japan's space technology depends almost completely on foreign countries, and its market is very limited. Sales of the space industry here totaled ¥105,400 million in FY 1978. Of this amount, ¥53,800 million was for rockets, satellites and related products, and ¥47,000 million for ground communications equipment. Exports during that year totaled ¥23,600 million, about 97 percent of which was for ground support equipment.

Developing countries, especially those in Southeast Asia, have been increasing their space activities. ASEAN countries are reportedly studying joint use of communications and other satellites, MITI sources say.

The newly inaugurated study group is expected to study measures to help promote the Japanese space industry, especially to meet requirements on broadcasting, communications, weather observation and search of earth resources, the sources say.

CSO: 4120

NASDA DRAFTS H-1 ROCKET SPECIFICATIONS

Tokyo JPE AVIATION REPORT-WEEKLY in English 3 Dec 80 pp 8-9

[Text] The National Space Development Agency (NASDA) has drafted specifications of the H-1 three-stage rocket for launching application satellites in the decade starting in 1985, and assigned Nissan Motor Co. to develop the third stage booster which is the most important.

Nissan has started research and development on components of the third stage booster. Full-scale development is planned to begin around 1982.

According to the specifications, the third stage booster must produce an average vacuum thrust of eight tons in order to launch a satellite weighing around 550 kilograms.

The booster will measure about two meters in length and 1.33 meters in diameter. It will weigh around two tons, including 1.85 tons of propellant.

Although Nissan has so far used carboxyl terminal polybutadiene (CTPB) for a composite solid propellant for Tokyo University's M rockets, hydroxyl terminal polybutadiene (HTPB) will be adopted for the H-1 to increase combustion efficiency. This is Japan's first application of HTPB as a rocket propellant. Nissan has started combustion tests to confirm the feasability of HTPB.

EPDM ethylene-propylene rubber will be used as an insulator between the motor and propellant for the first time. This material is lighter than synthetic rubber which has so far been used.

The motor's case will be made of highly reinforced titanium alloy with fair heat resistance to lighten the third stage. The case's average thickness will be only two to three milimeters. For the nozzle, carbon fiber reinforced plastic or other new composite materials will be adopted.

Nissan will give priority to reducing weight of the third stage because this stage has the greatest effect on the weight of a satellite.

The first test H-1 rocket comprising two stages will be fired at Tanegashima Space Center in the winter of 1986 and the first three-stage rocket in the winter of 1988. Nissan will adjust its H-1 rocket program to meet the test firing schedule of NASDA.

CSO: 4120

GOVERNMENT TO IMPORT H-1 ROCKET PARTS FROM U.S.

Tokyo JPE AVIATION REPORT-WEEKLY in English 10 Dec 80 pp 9-10

[Text] Japan will import some parts and materials of the H-1 rocket under domestic development from the United States on condition that it can use the US Space Shuttle for launching application satellites which the H-1 cannot cover.

This has been broadly agreed upon between the two, according to government sources. Notes to this effect will be exchanged shortly.

The agreement has solved a major problem involving H-1 parts and materials, laying the groundwork for a smooth H-1 development program, according to space development sources.

The H-1 which will succeed the N rocket is designed to launch application satellites larger than previous experimental satellites. Its second stage booster will use an engine burning liquid oxygen and hydrogen fuels.

Although Japan intends to develop second and third stage boosters and an inertial navigation system on its own, parts and materials corresponding to 10 percent of the total cost will have to be imported from the United States.

The government negotiated the deal with Washington over the past year. Japan's use of the Space Shuttle was proposed by the US in an apparent bid to check West Europe's drive for this country's utilization of the Ariane rocket under development. Japan accepted the proposal in exchange for US approval of the import.

CSO: 4120

JDA TO FABRICATE ADVANCED ROTOR SYSTEM IN FIVE YEARS

Tokyo JPE AVIATION REPORT-WEEKLY in English 17 Dec 80 p 8

[Text] The JDA will start research during the current fiscal year on an advanced helicopter rotor system including composite material blades and a new hub.

It has already ordered a wind tunnel model of the rotor system valued at ¥51,492,000 from Kawasaki Heavy Industries Ltd. (KHI). Delivery is scheduled for March 31, 1981.

Fabrication of a complete rotor system for actual mounting on a helicopter is expected to take five years, including FY 1980.

The advanced rotor system is designed to improve helicopter performance. Composite materials have already been used in blades of some helicopters for US forces. Although the composite material blade has little effect on weight, its strength can boost kinematic characteristics. The composite blade is also more durable than conventional blades.

As to military use, bullets can pierce the composite material blade without cracking it.

CSO: 4120

SCIENCE AND TECHNOLOGY

ADOPTION OF GUN FOR MBT DEPENDS ON TEST RESULTS

Tokyo JPE AVIATION REPORT-WEEKLY in English 17 Dec 80 p 9

[Text] Adoption of the TR&DI's 120mm smooth bore gun and APDSFS ammunition for a new main battle tank (MBT) will depend on results of technical evaluation tests conducted in late November.

The TR&DI has fabricated and tested the 120mm gun in consideration of the GSDF's MBT requirements. If the test results, now under study, reveal success of the gun and ammunition, full-scale development will start in FY 1982 with completion planned for FY 1988.

If the TR&DI fails to prove by the end of FY 1980, however, a foreign gun will be introduced as the main gun of the new MBT.

A promising foreign condidate for the main gun is Rheinmetall GmbH's 120mm smooth bore gun, which is mounted on the US Army's XM-1 tank.

CSO: 4120

JDA TO PROCURE SOFTER-RECOIL GUN COMPONENTS IN FY '80

Tokyo JPE AVIATION REPORT-WEEKLY in English 17 Dec 80 p 9

[Text] JDA's Central Procurement Office has decided to order a sighting system and a chassis for a self-propelled softer-recoil gun under research from Japan Steel Works Ltd. and Komatsu Ltd., respectively.

About ¥430 million is contained in the FY 1980 budget for fabrication of the two components. Of this about ¥250 million is for the sighting system and about ¥170 million for the chassis, according to informed sources. However, there is a gap between the amount and the two companies' estimates. Therefore, necessary coordination is expected to delay formal contracts until early next year.

The self-propelled softer-recoil gun is designed as an antitank weapon for the GSDF. Fabrication in the current fiscal year is based on past research.

Fabrication is aimed at obtaining technical data before mounting a 105mm SR gun on the chassis.

The gun is being tested on the chassis of a Model 74 105mm self-propelled howitzer. Following fabrication in the current fiscal year, tests and full-scale development are expected to start in FY 1981.

CSO: 4120

BRIEFS

DEVELOPMENT OF SOUND LOCATOR--The Technical R&D Institute (TR&DI) of the JDA is expected to start technical development of a LQO-4 submerged fixed sound locator for antisubmarine surveillance for the Maritime Self-Defense Force (MSDF) in FY 1982 after final test fabrication in FY 1979. It intends to prepare performance requirements by the end of FY 1980 or March 1981. The LQO-4 sensor will replace the existing LQO-3 for coastal and port submarine surveillance. Procurement of LQO-3 sensors was suspended in FY 1975. Research on the LQO-4 started under the 1967-71 Third Defense Buildup Program. As the MSDF demanded improved operational ability, the TR&DI fabricated a submerged subsystem for further research from FY 1978 and a display device for multiple underwater targets in FY 1979. Basic research has now been completed, paving the way for technical development. Funds for technical development are expected to exceed ¥2,000 million. Research funds in FY 1978 and 1979 totaled about ¥1,000 million. [Text] [Tokyo JPE AVIATION REPORT-WEEKLY in English 10 Dec 80 pp 8,9]

JET ENGINE FOR NEW SSM--The TR&DI started tests of a prototype jet engine for a new surface-to-surface missile (SSM) at its Third R&D Center in November. the initial stage of the ongoing running tests has produced satisfactory results. The prototype engine was delivered to the TR&DI by Mitsubishi Heavy Industries Ltd. (MHI) in September. Although the new SSM is based on the ASM-1 antiship missile designed for the F-1 support fighter, a jet engine is adopted instead of the ASM-1' solid fuel rocket to increase cruising range. Operational requirements of the jet powered engine are different from those of jet aircraft engines. Since a missile engine is only used once, the engine must be simplified to reduce cost. It also must be ready for firing at any time even without maintenance. The TR&DI ordered two prototype engines and a complete missile design from MHI in FY 1979. Following the engine for the ongoing tests, another will be delivered by the end of this year. In the current fiscal year, TR&DI will place orders with MHI for a guidance system and an inertial navigation system as well as additional engines. [Text] [Tokyo JPE AVIATION REPORT-WEEKLY in English 10 Dec 80 p 9]

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